
THE SANITARY INSTITUTE, INCORPORATED 1888.
SALUS GENERIS HUMANI.

1892.

TRANSACTIONS

OF

THE SANITARY INSTITUTE.

VOLUME XIII.

(Being Volume IV. of The Transactions published since the Incorporation of the Institute.)

CONGRESS AT PORTSMOUTH.

1892.

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1893.

EDITING COMMITTEE.

The Institute is not responsible for the facts and opinions advanced in the Addresses and Papers published in the Transactions.

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PREFACE.

The present Volume is principally a record of the Congress held at Portsmouth; it is rather larger than usual, as it has been thought advisable to give either the text or abstract of the papers read at the five Conferences which were organised in connection with the Congress.

The Volume also contains the papers read at the Sessional Meetings, with the discussions that followed, and an address by Sir Douglas Galton, delivered at Worcester to inaugurate the course of lectures to Sanitary Officers organised by the Institute.

A full record of the two years' work will be found in the Annual Reports on pages 14 and 25, and particulars of the Examinations, List of Donations to the Library, and other matters of interest are given at the end of the Volume.

Congresses held by the Institute.

LEAMINGTON, 1877.

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STAFFORD, 1878.

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„ II.—Captain Douglas Galton, R.E., C.B., D.C.L., F.R.S.
„ III.—G. J. Symons, F.R.S.

EXETER, 1880.

President.—THE RIGHT HON. EARL FORTESCUE.

Presidents of Sections.

Section I.—Prof. de Chaumont, M.D., F.R.S.
„ II.—R. Rawlinson, M.Inst.C.E., C.B.
„ III.—Sir Antonio Brady.

NEWCASTLE-UPON-TYNE, 1882.

President.—CAPT. DOUGLAS GALTON, R.E., C.B., D.C.L., F.R.S.

Presidents of Sections.

Section I.—Denis Embleton, M.D., F.R.C.S.
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„ III.—Arthur Mitchell, M.A., M.D., LL.D., F.R.S.

GLASGOW, 1883.

President.—PROF. G. M. HUMPHRY, M.D., F.R.S.

Presidents of Sections.

Section I.—Prof. W. T. Gairdner, M.D., LL.D.
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DUBLIN, 1884.

President.—SIR ROBERT RAWLINSON, C.B.

Presidents of Sections.

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„ II.—C. P. Cotton, M.Inst.C.E.
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LEICESTER, 1885.

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YORK, 1886.

President.—SIR SPENCER WELLS, BART.

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" III.—WILLIAM WHITAKER, B.A.. F.G.S.

BOLTON, 1887.

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" III.—PROF. A. DUPRÉ, PH.D., F.I.C., F.C.S., F.R.S.
Conference of M.O.H.—PROF. W. H. CORFIELD, M.A., M.D.

WORCESTER, 1889.

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Conference of M.O.H.—PROF. W. H. CORFIELD, M.A., M.D.

BRIGHTON, 1890.

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" III.—WILLIAM TOPLEY, F.R.S., F.G.S.
Conference of M.O.H.—ARTHUR NEWSHOLME, M.D., D.P.H.
Conference of Inspectors of Nuisances—ALFRED CARPENTER, M.D., M.R.C.P. D.P.H.

PORTSMOUTH, 1892.

President.—SIR CHARLES CAMERON, M.D., F.R.C.S.I., D.P.H.

Presidents of Sections.

Section I.—PROF. J. LANE NOTTER, M.D.
" II.—JAMES LEMON, M.INST.C.E., F.R.I.B.A.
" III.—W. J. RUSSELL, PH.D., F.R.S.
Conference of Naval and Military Hygienists—INSPECTOR-GENERAL J. D. MACDONALD, M.D., F.R.S.
Conference of Medical Officers of Health—PROF. C. KELLY, M.D.
Conference of Municipal and County Engineers—H. PERCY BOULNOIS, M.INST.C.E.
Conference of Sanitary Inspectors—PROF. A. WYNTER BLYTH.
Conference on Domestic Hygiene—LADY DOUGLAS GALTON.

THE SANITARY INSTITUTE.

FOUNDED 1876.—INCORPORATED 1888.

REPORT OF THE COUNCIL

Read at the Ordinary General Meeting, March 15th, 1892.

The rapid growth of the Institute, financially, numerically, and also in its public work and official recognition, which is almost unprecedented in the annals of any similar Society, has steadily continued during the past year, and the Council are glad to be able to present to the Fellows and Members a Report showing the increasing work and usefulness of the Institute, indicating as it does the larger share of public attention given to Sanitary matters.

SESSIONAL MEETINGS.

Sessional Meetings were held in February, March, and December. The following papers were read and discussed :—

"Model Dwellings in London, and Over-crowding on space," by Louis Parkes, M.D., D.P.H.

"The Prevention of Infectious Diseases," by Prof. A. Wynter Blyth, M.R.C.S.

"The Sewerage of Maldon, Essex, with some observations on recent practice in Sewer Ventilation," by R. F. Grantham, M.INST.C.E.

LENT LECTURES FOR LADIES.

A course of Lectures on Domestic Hygiene, especially intended for Ladies, was given during Lent by Dr. A. T. Schofield, and included the following subjects :—

"Domestic Treatment of Disease."

"Microbes."

"Physical Culture."

"The Care of Old Age."

The Lectures were well attended, and, at a Special Meeting held at the close of the Course, Her Royal Highness the Duchess of Albany presented Certificates to 22 Ladies who had written satisfactory reports upon the Lectures.

LECTURES FOR SANITARY OFFICERS.

Two courses of Lectures and Demonstrations for Sanitary Officers have been held during the year. The first course was held in February and March, and the second in October and November.

One hundred and sixty-one Students entered their names for these Lectures.

The sixteen Lectures comprised in the course were:—

"Ventilation, Warming and Lighting." Sir Douglas Galton, K.C.B., D.C.L., LL.D., F.R.S.

"Principles of Calculating Areas, Cubic Space, &c.; Interpretation of Plans and Sections to Scale." Mr. H. Law, M.INST.C.E.

"Water Supply, Drinking Water, Pollution of Water." In the first course by Dr. Louis Parkes, and in the second by Dr. G. Reid, D.P.H., Medical Officer, Staffordshire County Council.

"Drainage." Prof. H. Robinson, M.INST.C.E.

"Sanitary Building Construction." Mr. P. Gordon Smith, F.R.I.B.A.

"Sanitary Appliances." Prof. W. H. Corfield, M.A., M.D. Oxon., Medical Officer of Health, St. George's, Hanover Square.

"Details of Plumbers' Work." Mr. J. Wright Clarke.

"Scavenging, Disposal of Refuse and Sewage." Mr. Charles Jones, M.INST.C.E., Engineer and Surveyor to Ealing Local Board.

"Infectious Diseases and Methods of Disinfection." Mr. Shirley F. Murphy, M.R.C.S., Medical Officer of Health for the County of London.

"General Powers and Duties of Inspectors of Nuisances." Mr. J. F. J. Sykes, M.B, B.SC., Medical Officer of Health, St. Pancras.

"Objects and Methods of Inspection." Mr. J. F. J. Sykes, M.B., B.SC., Medical Officer of Health, St. Pancras.

"Trade Nuisances." Prof. A. Bostock Hill, M.D., S.SC.CERT.CAMB., F.I.C.

"Diseases of Animals in relation to Meat Supply; Characteristics of Vegetables, Fish, &c., unfit for Food." Prof. A. Wynter Blyth, Barrister-at-Law, M.R.C.S., Medical Officer of Health for St. Marylebone.

"Nature of Nuisances, including Nuisances the abatement of which is difficult." Mr. J. F. J. Sykes, M.B., B.SC., Medical Officer of Health, St. Pancras.

"Sanitary Law. English, Scotch, and Irish; General Enactments; Public Health Act, 1875; Model Bye-Laws, &c." Prof. A. Wynter Blyth, Barrister-at-Law, M.R.C.S., Medical Officer of Health for St. Marylebone.

"Sanitary Laws and Regulations governing the Metropolis." Prof. A. WYNTER BLYTH, Barrister-at-Law, M.R.C.S., Medical Officer of Health for St. Marylebone.

Arrangements are made in connection with these Lectures for the Students to visit Works for the Treatment of Sewage, Refuse destruction, and other public purposes.

The Council desire to record their sincere thanks to the Lecturers for the great benefits they have conferred upon the Students by the preparation and delivery of these Lectures.

The Lectures have now been carried on for six years with marked success, but have hitherto been confined to London. In 1891, however, the Council in conjunction with the County Council of Staffordshire, established a similar but somewhat shorter course in Stafford. The Lectures were attended by forty-four Students, and their beneficial effect was clearly shown in the results of the Examination which followed the Lectures.

The Council are now arranging to extend these courses to several other provincial towns, securing, as far as possible, the co-operation of the County Councils.

EXAMINATIONS.

During the year two Examinations for Inspectors and one for Local Surveyors have been held in London, and Examinations for Inspectors of Nuisances have also been held at Birmingham, Manchester, Newcastle, and Stafford. At these Examinations 350 Candidates presented themselves for Examination as Inspectors of Nuisances, and eleven as Local Surveyors ; 238 received Certificates, of Competency as regards their Sanitary knowledge to discharge the duties of Inspectors of Nuisances, and eight those of Local Surveyors.

Since these Examinations were first established forty Examinations have been held, and 1,493 Candidates have been examined, of whom 825 have passed the Examination for Inspectors of Nuisances, and 78 that for Local Surveyors.

The provincial Examinations have proved so successful and have been so much appreciated by Local Authorities and by Candidates, that it has been found desirable to considerably increase the number of centres at which they are held.

The importance of appointing duly qualified officers is now very generally recognized, and at the instigation of the Institute, a clause requiring qualifying Certificates for Inspectors was added to the Public Health (London) Act, 1891. The desirability of a Certificate

of Competency for Sanitary Inspectors is definitely recognized by the City Commissioners of Sewers, by twenty-six other Sanitary authorities in the metropolis, and by Liverpool, Manchester, Southampton, and sixty-one other authorities in the provinces; in the majority of these the holding of a Certificate from the Institute is one of the conditions of appointment.

The Council feel that this work of Examination in which the Institute has been engaged for the past fifteen years is now bearing good fruit, and the following reference to this work appears in the Report of the Mansion House Council on the Dwellings of the Poor:—*

"The status of Sanitary Inspectors, or, as they are sometimes designated, Inspectors of Nuisances, continues to improve. To the Lectures and Examinations of the Sanitary Institute this is chiefly due, and in a lesser degree to the public demand for men with a little more proficiency and ability than satisfied Vestries formerly. The most captious critic would now find the test Examination severe and searching, and in most of the advertisements for Inspectors we have been glad to notice that the possession of the Sanitary Institute Certificate has been rigorously insisted upon. In any comprehensive measure that is brought forward dealing with Sanitary matters, it is to be hoped that a Governmental sanction will be given to this Examination."

It has frequently been represented to the Council that there are a number of clerks of works, builders' foremen, and others holding similar positions who are anxious to obtain a Sanitary Certificate, and that the Syllabus of the Examination for Inspectors of Nuisances does not correspond with their duties and requirements. To meet this growing desire the Council have now arranged, in conjunction with the Worshipful Company of Carpenters, an Examination suitable for the officers referred to, and this Examination will be preceded by a course of preparatory Lectures.

CONGRESS.

The Provincial Congress and Exhibition, usually held by the Institute, were omitted in 1891, on account of the meeting of the International Congress of Hygiene and Demography.

This Congress had arranged to hold its Meeting in London, on the invitation of the Sanitary Institute and the Society of Medical Officers of Health, and was presided over by H.R.H. the Prince of Wales, with Sir Douglas Galton, as Chairman of the Organising and Executive Committee.

* Dwellings of the Poor. Report of the Mansion House Council, for the year ending December 31st, 1890. (Page 29.)

A Special Meeting was held in the Museum for the reception of the Members of the Congress, and was attended by about 500 persons.

PARLIAMENTARY WORK.

The most important Sanitary legislation of the year was the Consolidation and Amendment of the Public Health Statutes relating to the Metropolis, and a number of suggestions and amendments were prepared by the Institute, and brought before Parliament in the House of Commons, by Sir Guyer Hunter and Mr. F. S. Powell: and in the House of Lords by the Right Hon. Earl Kimberley, Right Hon. Earl Fortescue, Lord Thring, Lord Basing, and others. Amongst the suggestions of the Sanitary Institute that were adopted by Parliament may be specially mentioned those relating to structural requirements of Cellar Dwellings, as well as the regulation already referred to, which requires that after January 1st, 1895, all newly-appointed Inspectors shall hold a Certificate of qualification, unless they have had three years experience in a London district, or in a town containing upwards of 20,000 inhabitants.

MUSEUM.

The re-arrangement of the Museum, which was provided for by the liberal gift of Mr. Rogers Field, has been successfully carried out, and many new and instructive exhibits have been added; such as a full-size sectional model of house-drainage, models of damp-proof construction, water-fittings, &c. A complete Catalogue has been prepared, and will be issued to members in the Volume of Transactions.

The Council have appointed Mr. W. H. Knight (who arranged the Museum and Catalogue under the direction of the Committee) as Curator, to continue the improvement of the Museum and to assist visitors in their examination of the various exhibits.

These measures have largely increased the usefulness of the Museum for the purpose of Instruction, and it appears to be more than ever appreciated by the public as well as by teachers and professors. The Museum is open free to the public, and about 11,500 persons have visited it during the year.

The Examiners of the Joint Board of the Royal College of Physicians and Royal College of Surgeons, the Army Sanitary Committee, and also the Professors and Lecturers to many of the London Medical Schools, have availed themselves of the practical advantages

afforded by the Museum; 39 classes have been held in it, numbering altogether 411 students.

The Council are glad to note that similar Museums are being established in several towns abroad, and applications for information and assistance are made to the Institute.

LIBRARY.

The use of the Library is steadily increasing; during the year there have been 546 readers.

333 volumes and pamphlets have been added to the Library during the year. A list of these will be found in Volume XII. of the Transactions.

EPITOME OF REGISTERS OF MEMBERS AND ASSOCIATES.

	Hon. Fellows.	Fellows.	Members.	Associates.	Total.
Dec. 31, 1890	28	151	423	329	931
Elected	—	+5	+59	+141	+205
Transferred	—	—	–5	–2	–7
Resigned	—	—	–13	–5	–18
Erased	—	—	–7	–13	–20
Dead................	–1	–2	–7	–3	–13
Dec. 31, 1891	27	154	450	447	1078

The Council are glad to note this rapid and continued increase in the Institute.

It is with much regret that the Council have to report the death of:—M. Alphand, Hon. Fellow; R. B. Grantham, M.INST.C.E., and Prof. John Marshall, F.R.S., Fellows; W. Aldam, E. G. Banner, W. W. Day, M.D., D.P.H., J. T. Donald, L.R.C.S., G. K. Hardie, M.D., G. Moseley, F.R.C.S., and W. E. Steavenson, M.D., Members; Philip Cheek, Robert Slater, and F. E. Sleath, Associates.

FINANCE.

The Statement of Income and Expenditure for the year shows a satisfactory progress in the Financial Position of the Institute.

DOUGLAS GALTON, K.C.B.,

Chairman of Council.

E. WHITE WALLIS, *Secretary.*

9*th March*, 1892.

STATEMENT of INCOME and EXPENDITURE, for the Year ended 31st December, 1891.

Dr.

Expenditure.	£	s.	d.	£	s.	d.
To Transactions, Cost of Printing, &c., less Sales and Advertisements—estimated	35	8	6			
,, Sessional Meetings	19	1	0			
,, Lectures, Sanitary Officers	54	19	10			
,, ,, Domestic Hygiene	34	18	11			
,, Examinations	711	10	1			
,, Illustrated List of Awards	4	0	6			
,, International Congress of Hygiene	25	16	1			
				885	14	11
,, Rent, Rates, Taxes, and Insurance	260	15	3			
,, Salaries and Wages	563	18	0			
,, Coals and Care of Offices	29	0	1			
,, Repairs and Alterations	77	9	5			
,, Arrangement of Museum	250	0	0			
,, Library, Binding, &c.	5	19	11			
,, Postage and Carriage	71	2	1			
,, Printing and Stationery	97	17	6			
,, Advertising	11	4	9			
,, Incidental Expenses	46	1	5			
,, Alfred Lass & Co., Auditing Accounts	10	10	0			
,, Office Furniture	17	12	0			
,, Depreciation of Leasehold	50	0	0			
				1491	10	5
				2377	5	4
,, Balance for the year 1891				90	6	1
				£2467	11	5
,, Balance to be carried forward				£2110	0	6

Cr.

Income.	£	s.	d.	£	s.	d.
By Annual Subscriptions	643	14	0			
,, Entrance Fees	91	7	0			
,, Life Compositions	63	0	0			
,, Fellowship Fees	26	5	0			
,, Donations	9	8	6			
				833	14	6
,, ,, for Re-arrangement of Museum				250	0	0
,, Lectures, Sanitary Officers	114	10	0			
,, ,, Domestic Hygiene	26	10	0			
,, Examinations	1228	1	3			
,, Publications—Farr's and Simon's—Profit on Sales	7	6	7			
,, Interest on Deposit	7	9	1			
				1383	16	11
				£2467	11	5
By Balance brought forward from last Account				2019	14	5
,, Profit on Year 1891				90	6	1
				£2110	0	6

Examined and approved, ALFRED LASS & CO., Chartered Accountants, MAGNUS OHREN, Assoc.M.Inst.C.E., } *Auditors.*

March 7th, 1892.

GENERAL BALANCE SHEET, 31st DECEMBER, 1891.

Liabilities.	£	s.	d.
To Subscriptions paid in advance for 1892	41	9	6
,, Examination Fees ,, ,,	20	9	6
,, Exhibition Account Balance	14	4	8
,, Sundry Creditors	314	1	9
	390	5	5
Balance of Assets over Liabilities	2110	0	6
	£2500	5	11

Assets.	£	s.	d.	£	s.	d.
By Lease of Premises, 9 years unexpired...				444	3	8
,, Library and Contents of Museum, estimated value				500	0	0
,, Furniture and Fixtures, estimated value				100	0	0
,, Transactions and Publications, estimated value	516	8	6			
,, Farr's Works, estimated value	35	5	0			
,, Simon's ,, ,,	101	10	0			
				653	3	6
,, Sundry Debtors—						
Members' Subscriptions and Arrears	79	5	6			
,, ,, from old Societies	12	12	0			
Fellowship Fees	10	10	0			
Entrance Fees	33	12	0			
Sundries	13	7	6			
				149	7	0
,, Cash at Bankers				153	11	9
,, ,, ,, on Deposit				500	0	0
				£2500	5	11

Examined and approved,

ALFRED LASS & Co., Chartered Accountants, }
MAGNUS OHREN, Assoc.M.Inst.C.E. } *Auditors.*

March 7th, 1892.

ADDRESS

By Sir DOUGLAS GALTON, K.C.B., F.R.S.,

Chairman of Council.

Read at the Ordinary General Meeting, 1892.

As by the rules of the Institute I am about to resign my position as Chairman of Council, I will take this opportunity of making a few remarks.

I became Chairman of Council of the Parkes Museum at the end of 1882, and retained the position until the Museum was joined with The Sanitary Institute.

I was made Chairman of Council of The Sanitary Institute in 1885, and I then urged on The Sanitary Institute the importance of uniting with the Parkes Museum.

I have always felt the great evil of the separation of Sanitary Associations into several bodies, each of which fritters away influence, whereas by union and a concentration of influence the power for good of the Association is largely increased.

The two Societies were amalgamated and incorporated as the Sanitary Institute in 1888, under the provisions of the Companies Act and the license of the Board of Trade.

Since that time the growth of the Institute has been steady and fairly rapid.

As an instance of this growth I may mention that at the time of the amalgamation of the two Societies they jointly possessed 754 members. The Sanitary Institute now numbers 1,100 members.

The annual income of the two Societies in 1883 amounted to £1,700. The annual income of The Sanitary Institute is now nearly £4,000.

The Library, which was in its infancy in 1883, has now become probably one of the best Sanitary Libraries in the world.

The Museum, which my friend Mr. Twining did so much to foster in the early days of the Parkes Museum, has now—partly in consequence of the increased funds at the disposal of the Institute, but very largely in consequence of the munificence of Mr. Rogers Field—become a very valuable aid to Sanitary Instructors, and it is largely resorted to by teachers,

and used by them as a place for giving practical instruction to their classes of students.

You all know that the object for which The Sanitary Institute exists is to foster and diffuse Sanitary knowledge, not that Sanitary Science is a new science; but our progress in that comfort and well-being which we term civilisation, has the effect of developing new contingencies, which alter the conditions regulating the application of Sanitary knowledge. Whether in town or country we are daily brought into contact with many problems of Sanitation.

The other day Dr. Louis Parkes gave us an interesting speculation on the deterioration of air in towns, and of water in the country.

The evils of our congested population meet us at every turn. If our progenitors had been properly educated in Sanitary matters our towns would not have been allowed to contain unhealthy localities; houses would not have been permitted to be built on damp unhealthy sites; buildings would not have been constructed so as to impede the circulation of air and the incidence of light.

Our town populations would not have been allowed to grow up herded together like the beasts of the field, without moral training or self-restraint, and our country population would not have been allowed to destroy the healthy conditions which surround them, by vitiating the pure air, and by contaminating the springs of pure water.

The Sanitary Institute is thus the direct outgrowth of the public need for Sanitary Education. And we have therefore considered that whilst our Museum and Library fulfil what may be termed our passive function, we must obtain progress by active measures.

Our active operations consist of our Lectures and Examinations, our Congresses, and our Exhibitions.

The Lectures to Sanitary Officers, which we commenced in 1885, were a necessary consequence of the Examinations which we had initiated for Local Surveyors and Sanitary Inspectors.

We soon found that it was useless to hold Examinations if the examinees had no opportunity of acquiring knowledge of the subjects in which they were examined.

The number of Lectures in the course for Sanitary Inspectors, which was twelve in 1885, has been increased to seventeen, and whilst we commenced by holding two courses annually in London, we have now extended these courses to other parts of England. We give Lectures at Stafford, Derby, Cardiff, Newcastle, Wakefield, and Norwich, with the support of the several County Councils.

The Examinations which follow these Lectures have been attended by continually increasing numbers. In 1883 there were twenty who came up for examination. In 1891 there were 361, and we have examined 1493 candidates since we first began.

Special Lectures have been given annually to ladies during Lent under the patronage of H.R.H. the Duchess of Albany.

Lectures on Hygiene have been given to medical men, and, as you have heard, we have now instituted Lectures and Examinations in conjunction with the Carpenters' Company.

But our Congresses and Exhibitions have as great importance as a means of educating the people as our Lectures and Examinations. The town in which these are held has generally been found to acquire thereby an impetus in Sanitation; for instance, at Worcester it led to the formation of a Local County Health Society, and in other towns has had beneficial results. Moreover, now a main feature of the Congress is the Conferences of Medical Officers of Health and of Sanitary Inspectors.

The Exhibitions have a real value. At these the newest improvements in Sanitary appliances are brought forward. The Institute has inaugurated a most careful system of judging the Exhibits by giving stability to its court of Judges; that is to say, while a gradual change in the *personnel* of its judges is made annually on a systematic plan, yet the larger number of Judges remain from year to year, so that there has been a uniformity in the principle upon which the awards have been based. An essential feature in judging articles for award is the practical testing of those exhibits whose merit cannot otherwise be determined.

I trust I have said enough to show that The Sanitary Institute may fairly claim to have done a great work of public usefulness during its comparatively short career.

This work has not been achieved without a great tax upon the members of its Council. The Judges and the Lecturers, who, with the Examiners, are the mainstay of the Institute, give their services gratuitously, and our success has been due to the earnest self-sacrificing spirit of the Council, as well as that of the Secretary and other officers connected with the management of the Institute.

I confess that I resign the Chairmanship of the Council with some regret, but I am fully consoled with thinking that it will be occupied by equally earnest—and probably abler—men; that the spirit which has hitherto animated the Council will continue to prevail; and that future years will register greater successes than those gone by.

ANNUAL REPORT OF THE COUNCIL

Read at the Ordinary General Meeting, March 8th, 1893,

SIR THOMAS CRAWFORD, K.C.B., M.D., Q.H.S., LL.D.,
IN THE CHAIR.

In presenting this Sixth Annual Report since the incorporation, and the Seventeenth since the foundation of the Institute, the Council are glad to be able to state that the rapid progress in the work of the Institute recorded in past years has been steadily maintained.

SESSIONAL MEETINGS.

Sessional Meetings were held in February and March. The following papers were read and discussed :—

"Refuse Disposal," by C. JONES, M.INST.C.E., Engineer to the Ealing Local Board, and J. RUSSELL.

"The Air and Water of London: are they deteriorating?" by LOUIS PARKES, M.D., D.P.H., Medical Officer of Health for Chelsea.

The meetings were well attended, and the papers, with abstracts of the discussion upon them, will be published in Vol. XIII. of the Transactions.

LECTURES FOR LADIES.

A course of Lectures on Domestic Hygiene, especially intended for Ladies, was given during Lent, as follows :—

"The Phenomena of Life,"
"Food and Dietetics,"
"Physical and Mental Training of Children,"
"The Hygiene of District Visiting,"
} by Dr. A. T. SCHOFIELD.

"The Effects of Posture on the Health of School Children," by the Rev. J. R. BYRNE, M.A., H.M. Inspector of Schools.

The Lectures were illustrated by Diagrams, Microscopic Specimens, Food collections, School Desks and Fittings, and by an exhibition of Physical Drill given by the girls of the Montem Street Board School, under the direction of Miss Allison.

Her Royal Highness the Duchess of Albany was present at all the Lectures, and at the close of the Course a special meeting was held, at which the Duchess of Albany presented the Certificates awarded to ladies who had written satisfactory Reports on the Lectures.

LECTURES FOR SANITARY OFFICERS AND STUDENTS.

Two courses of Lectures and Demonstrations for Sanitary Officers have been held in London during the year. The first course was held in February and March, for which 84 Students entered their names, the average attendance at the Lectures being 75.

The Lectures comprised in this course were :—

1. Ventilation, Warming, and Lighting. Sir Douglas Galton, K.C.B., D.C.L., L.L.D., F.R.S.
2. Water Supply, Drinking Water, Pollution of Water. H. R. Kenwood, M.D., D.P.H.
3. House Drainage. Prof. H. Robinson, M.INST.C.E.; Professor of Engineering, King's College.
4. Sewage Disposal. Prof. H. Robinson, M.INST.C.E.
5. Sanitary Building Construction. P. Gordon Smith, F.R.I.B.A., Architect to the Local Government Board.
6. Sanitary Appliances. Prof. W. H. Corfield, M.A., M.D.OXON., Professor of Hygiene and Public Health, University College, London, Medical Officer of Health for St. George's, Hanover Square.
7. Details of Plumbers' Work. J. Wright Clarke.
8. Scavenging, Disposal of Refuse. C. Jones, M.INST.C.E., Engineer to the Ealing Local Board.
9. Diseases of Animals in relation to Meat Supply; Characteristics of Vegetables, Fish, &c., unfit for Food. Prof. A. Wynter Blyth, Barrister-at-Law, M.R.C.S., Medical Officer of Health for St. Marylebone.
10. Infectious Diseases and Methods of Disinfection. Shirley F. Murphy, M.R.C.S., Medical Officer of Health to the London County Council.

11. General Powers and Duties of Inspectors of Nuisances. J. F. J. SYKES, M.B., B.SC., D.P.H., Medical Officer of Health for St. Pancras.
12. Objects and Methods of Inspection. J. F. J. SYKES, M.B., B.SC., D.P.H.
13. Nature of Nuisances, including Nuisances the abatement of which is difficult. J. F. J. SYKES, M.B., B.SC., D.P.H.
14. Trade Nuisances. PROF. A. BOSTOCK HILL, M.D., D.P.H., F.I.C., Professor, Queen's College, Birmingham.
15. Sanitary Law. English, Scotch, and Irish; General Enactments; Public Health Act, 1875; Model Bye-Laws, &c. PROF. A. WYNTER BLYTH, Barrister-at-Law, M.R.C.S., Medical Officer of Health for St. Marylebone.
16. Sanitary Laws and Regulations Governing the Metropolis. PROF. A. WYNTER BLYTH, Barrister-at-Law, M.R.C.S.,
17. Principles of Calculating Areas, Cubic Space, &c.; Interpretation of Plans and Sections to Scale. PROF. T. ROGER SMITH, F.R.I.B.A.

At the second course, in October and November, 128 students entered their names, the average attendance at the Lectures being 119.

The Lectures comprised in the second course were:

1. Ventilation, Warming and Lighting. SIR DOUGLAS GALTON, K.C.B., D.C.L., LL.D., F.R.S.
2. Principles of Calculating Areas, Cubic Space, &c.; Interpretation of Plans and Sections to Scale. H. LAW, M.INST.C.E.
3. Water Supply, Drinking Water, Pollution of Water. LOUIS PARKES, M.D., D.P.H.LOND. Medical Officer of Health for Chelsea.
4. House Drainage. W. C. TYNDALE, ASSOC. M.INST.C.E.
5. Sewage Disposal. PROF. H. ROBINSON, M.INST.C.E., Professor of Engineering, King's College.
6. Sanitary Building Construction. H. H. COLLINS, F.R.I.B.A., District Surveyor for Eastern Division, City of London.
7. Sanitary Appliances. PROF. W. H. CORFIELD, M.A., M.D.OXON., Professor of Hygiene and Public Health, University College, London; Medical Officer of Health for St. George's, Hanover Square.

8. Details of Plumbers' Work. J. Wright Clarke.
9. Scavenging, Disposal of Refuse. T. De Courcy Meade, M.INST.C.E., Engineer to the Hornsey Local Board.
10. Diseases of Animals in relation to Meat Supply; Characteristics of Vegetables, Fish, &c., unfit for Food. Prof. A. Wynter Blyth, Barrister-at-Law, M.R.C.S., Medical Officer of Health for St. Marylebone.
11. Infectious Diseases and Methods of Disinfection. Shirley F. Murphy, M.R.C.S., Medical Officer of Health to the London County Council.
12. General Powers and Duties of Inspectors of Nuisances. J. F. J. Sykes, M.B., B.SC., D.P.H., Medical Officer of Health for St. Pancras.
13. Objects and Methods of Inspection. J. F. J. Sykes, M.B., B.SC., D.P.H.
14. Nature of Nuisances, including Nuisances the abatement of which is difficult. J. F. J. Sykes, M.B., B.SC., D.P.H.
15. Trade Nuisances. Prof. A. Bostock Hill, M.D., S.SC.C.CAMB., F.I.C., Professor at Queen's College, Birmingham.
16. Sanitary Law. English, Scotch, and Irish; General Enactments; Public Health Act, 1875; Model Bye-Laws, &c. Prof. A. Wynter Blyth, Barrister-at-Law, M.R.C.S., Medical Officer of Health for St. Marylebone.
17. Sanitary Laws and Regulations Governing the Metropolis. Prof. A. Wynter Blyth, Barrister-at-Law, M.R.C.S.

Arrangements were made in connection with these Lectures for the Students to visit the—

Sewage Disposal and Refuse Destructor Works, Ealing.
Beddington Sewage Farm, Croydon.
Model Dairy (Welford & Son).
Refuse Disposal Works, Chelsea.
Sanitary Depôt, Sewage Disposal Works, Isolation Hospital, Highgate.
Model Cow-House, Finsbury Park.
Wimbledon Sewage Farm.
Knacker's yard (Harrison & Barber).
East London Soap Works (E. Cook & Co.).
Disinfecting Apparatus (Washington Lyons), St. George's Hospital.

PROVINCIAL LECTURES.

Lectures in the provinces, which were commenced in 1891, have been greatly extended, and arrangements were made for Courses ot Lectures to Sanitary Officers at the following Towns in conjunction with the County Councils or Corporations.

County Council of Derbyshire	Derby.
The West Riding County Council, The Yorkshire College, The County Boroughs of Halifax, Huddersfield, and Sheffield . .	Wakefield.
The Corporation of Cardiff	Cardiff.
The Corporation of Newcastle-upon-Tyne .	Newcastle-upon-Tyne.
The County Council of Norfolk	Norwich.
The Corporation of Liverpool	Liverpool.
The County Council of Worcestershire . .	Worcester.

620 Students entered their names for these Lectures. The total attendances at all the Lectures being over 7,000, or an average of 84 at each Lecture.

The courses at the various centres consisted of the following Lectures:—

Derby.

1. Introductory, and on Ventilation, Heating and Lighting. Sir Douglas Galton, K.C.B., D.C.L., LL.D., F.R.S.
2. Principles of Calculating Areas, Cubic Space, &c.; Interpretation of Plans and Sections to Scale. F. S. Granger, M.A., A.R.I.B.A.
3. Sanitary Building Construction. Keith D. Young, F.R.I.B.A.
4. House Drainage and Sanitary Appliances. Prof. W. H. Corfield, M.A., M.D., &c., Professor of Hygiene and Public Health, University College, London; Medical Officer of Health for St. George's, Hanover Square.
5. Details of Plumbers' Work. William Wilkinson, R.P.C., Chief Sanitary Inspector, Derby.
6. Scavenging and Disposal of Refuse. J. C. Thresh, M.B., D.SC.LOND., F.R.MET.SOC., Medical Officer of Health to the Mid-Essex combined R.S.A. and to the Essex County Council.

7. Sewage Disposal—*(a)* of Large Houses; *(b)* of Small Villages; *(c)* of Small Towns. W. H. Radford, assoc.m.inst.c.e.

8. Water Supply, Drinking Water, Pollution of Water. George Reid, m.d., d.p.h., Medical Officer of Health to the Staffordshire County Council.

9. Diseases of Animals in relation to Meat Supply; Characteristics of Vegetables, Fish, &c., unfit for food. Prof. A. Wynter Blyth, Barrister-at-Law, m.r.c.s., Medical Officer of Health for St. Marylebone.

10. Infectious Diseases and Methods of Disinfection. Prof. A. Bostock Hill, m.d., s.sc.c.camb., f.i.c., Professor at Queen's College, Birmingham.

11. Nuisances and Offensive Trades. S. Barwise, m.b.lond., d.p.h., Medical Officer of Health to the Derbyshire County Council.

12. Powers and Duties of Sanitary Inspectors. S. Barwise, m.b.lond., d.p.h.

13. Sanitary Law, General Enactments, Public Health Act, 1875, Model Bye-Laws, &c. Prof. A. Wynter Blyth, Barrister-at-Law, m.r.c.s., Medical Officer of Health for St. Marylebone.

Wakefield.

1. Qualifications and Duties of Sanitary Inspectors. F. W. Barry, m.d., Local Government Board Inspector (Medical Department).

2. Nuisances and Insanitary Conditions. J. Spottiswoode Cameron, m.d., Medical Officer of Health for Leeds.

3. Ventilation, Warming and Lighting. Harvey Littlejohn, m.b., Medical Officer of Health for Sheffield.

4. Sanitary Construction of Buildings. J. Vickers Edwards, County Surveyor for the West Riding.

5. House Drainage. J. A. Bean, Deputy County Surveyor for the West Riding.

6. Sewerage and Sewage Disposal. Edward R. S. Escott, m.inst.c.e., Borough Engineer for Halifax.

7. Disposal of Refuse. J. Mitchell Wilson, m.d., Medical Officer of Health for Doncaster Borough and Doncaster Combined Sanitary Districts.

8. Water Supplies. W. ARNOLD EVANS, M.D., Medical Officer of Health for Bradford.

9. Food Supplies. JOHN W. MASON, M.B., Medical Officer of Health for Hull.

10. Milk. Prof. A. WYNTER BLYTH, Barrister-at-Law, M.R.C.S., Medical Officer of Health for St. Marylebone.

11. Sanitary Law. JAMES R. KAYE, M.B., Medical Officer of Health for Huddersfield.

12. Infectious Diseases and Disinfection. ARTHUR WHITELEGGE, M.D., Medical Officer to the West Riding County Council.

CARDIFF.

1. Introductory.—House Drainage and Sanitary Appliances. PROF. A. WYNTER BLYTH, Barrister-at-Law, M.R.C.S., Medical Officer of Health for St. Marylebone.

2. Sanitary Building Construction. KEITH D. YOUNG, F.R.I.B.A.,

3. Water Supply, Drinking Water, Pollution of Water. EDWARD WALFORD M.D., D.P.H.CAMB., Medical Officer of Health for Cardiff.

4. Details of Plumbers' Work. W. H. ALLEN, R.P.C.

5. Drainage, Scavenging, Disposal of Refuse, and Sewage. W. HARPUR, M.INST.C.E., Borough Engineer for Cardiff.

6. Infectious Diseases and Methods of Disinfection. EDWARD WALFORD, M.D., D.P.H.CAMB., Medical Officer of Health for Cardiff.

7. Diseases of Animals in relation to Meat Supply; Characteristics of Vegetables, Fish, &c., unfit for food. PROF. A. WYNTER BLYTH, Barrister-at-Law, M.R.C.S., Medical Officer of Health for St. Marylebone.

8. Powers and Duties of Sanitary Inspectors. D. S. DAVIES, M.D. LOND., D.P.H. CAMB., Medical Officer of Health for Bristol.

9. Nuisances and Offensive Trades. PROF. A. BOSTOCK HILL, M.D., S.SC.C.CAMB., F.I.C., Professor at Queen's College, Birmingham.

10. Objects and Methods of Inspection. J. F. J. SYKES, M.B., B.SC., Medical Officer of Health for St. Pancras.

11. Food Adulteration, Sale of Food and Drugs Act. Thomas Hughes, F.I.C., F.C.S., Analyst for Borough of Cardiff.
12. Sanitary Law, General Enactments, Public Health Act, 1875, Model Bye-Laws, &c. Prof. A. Wynter Blyth, Barrister-at-Law, M.R.C.S., Medical Officer of Health for St. Marylebone.
13. Ventilation, Heating, and Lighting. P. Rhys Griffiths, M.B., B.SC.LOND.
14. Principles of Calculating Areas, Cubic Space, &c,; Interpretation of Plans and Sections to Scale. E. Foster, Chief Engineering Assistant to the Borough Engineer, Cardiff.

Newcastle-upon-Tyne.

1. Introductory, and on Ventilation, Heating and Lighting. Louis Parkes, M.D., D.P.H., Medical Officer of Health for Chelsea, London.
2. House Drainage and Sanitary Appliances. Prof. A. Wynter Blyth, Barrister-at-Law, M.R.C.S., Medical Officer of Health for St. Marylebone.
3. Sanitary Building Construction. Arthur J. Gale, F.R.I.B.A., F.S.I.
4. Details of Plumbers' Work. T. S. Brown, R.P.C.
5. Scavenging, and Disposal of Refuse. W. Howard Smith, ASSOC.M.INST.C.E., City Engineer, Carlisle.
6. Water Supply, Drinking Water, Pollution of Water. G. Reid, M.D., D.P.H., Medical Officer of Health to the Staffordshire County Council.
7. Diseases of Animals in relation to Meat Supply; Characteristics of Vegetables, Fish, &c., unfit for food. Francis Vacher, F.R.C.S., F.C.S.
8. Infectious Diseases and Methods of Disinfection. H. E. Armstrong, D.HY. (Durham), M.R.C.S., L.S.A., Medical Officer of Health for Newcastle-upon-Tyne.
9. Powers and Duties of Sanitary Inspectors; Nuisances and Offensive Trades. Thomas Eustace Hill, M.B., B.SC., Medical Officer of Health for South Shields.
10. Objects and Methods of Inspection. Alfred E. Harris, L.R.C.P., L.R.C.S., F.C.S., Medical Officer of Health for Sunderland.

11. Sanitary Law, General Enactments, Public Health Act (1875), Model Bye-Laws, &c. PROF. A. WYNTER BLYTH, Barrister-at-Law, M.R.C.S., Medical Officer of Health for St. Marylebone.

12. Principles of Calculating Areas, Cubic Space, &c.; Interpretation of Plans and Sections to Scale. W. MCCHLERY.

NORWICH.

1. Introductory.—Ventilation, Heating, and Lighting. SIR DOUGLAS GALTON, K.C.B., D.C.L., LL.D., F.R.S.

2. Sanitary Building Construction. PERCIVAL GORDON SMITH, F.R.I.B.A., Architect to the Local Government Board.

3. Water Supply, Drinking Water, Pollution of Water. Major LAMOROCK FLOWER, Sanitary Engineer to the Lee Conservancy Board.

4. House Drainage and Sanitary Appliances. W. C. TYNDALE, ASSOC.M.INST.C.E.

5. Scavenging, Disposal of Refuse, and Sewage. T. DE COURCY MEADE, M.INST.C.E., Engineer to the Local Board, Hornsey.

6. Infectious Diseases and Methods of Disinfection. J. C. THRESH, M.B., D.SC.LOND., F.R.MET.SOC., Medical Officer of Health for Mid-Essex combined R.S.A., and to the Essex County Council.

7. Diseases of Animals in relation to Meat Supply; Characteristics of Vegetables, Fish, &c., unfit for food. Prof. A. WYNTER BLYTH, Barrister-at-Law, M.R.C.S., Medical Officer of Health for St. Marylebone.

8. Powers and Duties of Sanitary Inspectors. J. F. J. SYKES, M.B., B.SC., Medical Officer of Health for St. Pancras.

9. Objects and Methods of Inspection. THOMAS W. CROSSE, F.R.C.S., Medical Officer of Health for Norwich.

10. Sanitary Law, General Enactments, Public Health Act, 1875 Model Bye-Laws, &c. J. F. J. SYKES, M.B., B.SC., Medical Officer of Health for St. Pancras.

11. Principles of Calculating Areas, Cubic Space, &c.; Interpretation of Plans and Sections to Scale. HENRY LAW, M.INST.C.E.

12. Nuisances and Offensive Trades. A. NEWSHOLME, M.D., D.P.H., Medical Officer of Health for Brighton.

Liverpool.

1. Introductory, and on Ventilation, Heating and Lighting. Louis Parkes, M.D., D.P.H., Medical Officer of Health, for Chelsea.
2. House Drainage and Sanitary Appliances. H. Percy Boulnois, M.INST.C.E., City Engineer, Liverpool.
3. Sanitary Building Construction. T. Harnett Harrisson, ASSOC.M.INST.C.E., F.R.I.B.A.
4. Details of Plumbers' Work. J. Wright Clarke.
5. Scavenging, and Disposal of Refuse. John Price, ASSOC.M.INST.C.E., Surveyor to the Local Board, Toxteth Park.
6. Water Supply, Drinking Water, Pollution of Water. Joseph Parry, M.INST.C.E., Waterworks Engineer, Liverpool.
7. Diseases of Animals in relation to Meat Supply; Characteristics of Vegetables, Fish, &c., unfit for Food. Francis Vacher, F.R.C.S., F.C.S.
8. Infectious Diseases and Methods of Disinfection. H. E. Armstrong, D.HYG., Durham, M.R.C.S., Medical Officer of Health for Newcastle-upon-Tyne.
9. Powers and Duties of Sanitary Inspectors; Nuisances and Offensive Trades. J. F. J. Sykes, M.B., B.SC., Medical Officer of Health for St. Pancras.
10. Objects and Methods of Inspection. E. W. Hope, M.D., Assistant Medical Officer of Health for Liverpool.
11. Principles of Calculating Areas, Cubic Space, &c.; Interpretation of Plans and Sections to Scale. W. Goldstraw, Surveyor of Buildings, Liverpool.
12. Sanitary Law, General Enactments, Public Health Act, 1875, Model Bye-Laws, &c. Prof. A. Wynter Blyth, M.R.C.S., Barrister-at-Law, Medical Officer of Health for St. Marylebone.

Worcester.

1. Introductory. Sir Douglas Galton, K.C.B., D.C.L., LL.D., F.R.S.
2. Ventilation, Heating and Lighting. Sir Douglas Galton, K.C.B., D.C.L., LL.D., F.R.S.
3. Sanitary Building Construction. Keith D. Young, F.R.I.B.A.

4. Principles of Calculating Areas, Cubic Space, &c.; Interpretation of Plans and Sections to Scale. HENRY LAW, M.INST.C.E.
5. Water Supply, Drinking Water, Pollution of Water. GEORGE WILSON, M.A., M.D., F.R.S.E., Medical Officer of Health for Mid-Warwick.
6. Sewage Disposal—*(a)* of Large Houses; *(b)* of Small Villages; *(c)* of Small Towns. F. E. WILLCOX, ASSOC.M.INST.C.E.
7. Scavenging, and Disposal of Refuse. T. DE COURCY MEADE, M.INST.C.E., Surveyor to Local Board, Hornsey.
8. House Drainage and Sanitary Appliances. G. REID, M.D., D.P.H., Medical Officer of Health to the Staffordshire County Council.
9. Nuisances, Insanitary Condition, Offensive Trades, and Powers and Duties of Sanitary Inspectors. G. H. FOSBROKE, M.D., D.P.H.CAMB., Medical Officer of Health to the Worcestershire County Council.
10. Infectious Diseases and Methods of Disinfection. PROF. A. BOSTOCK HILL, M.D., S.SC.C.CAMB., F.I.C., Professor at Queen's College, Birmingham.
11. Diseases of Animals in relation to Meat Supply; Characteristics of Vegetables, Fish, &c., unfit for Food. ALFRED HILL, M.D., Medical Officer of Health for Birmingham.
12. Sanitary Law, General Enactments, Public Health Act, 1875, Model Bye-Laws, &c. PROF. A. WYNTER BLYTH, M.R.C.S., Barrister-at-Law, Medical Officer of Health for St. Marylebone.

The Council desire to record their sincere thanks, to the Lecturers both in London and the provinces for the great benefits they have conferred upon the Students, and for the assistance they have given to the diffusion of Sanitary knowledge, by the preparation and delivery of these Lectures, and also to those who took much trouble to make the various visits instructive to the Students.

EXAMINATIONS.

During the year two Examinations for Inspectors and one for Local Surveyors have been held in London, and Examinations for Local Surveyors have also been held at—

Derby.
Cardiff.

And for Inspectors of Nuisances at—

Bristol.	Cardiff.
Newcastle.	Norwich.
Derby.	Liverpool.
Wakefield.	

At these examinations 35 Candidates presented themselves for Examination as Local Surveyors, and 513 as Inspectors of Nuisances; 20 received Certificates of Competency, as regards their Sanitary knowledge, to discharge the duties of Local Surveyors, and 315 those of Inspectors of Nuisances.

Since these Examinations were first established 76 have been held, 30 for Local Surveyors, and 46 for Inspectors of Nuisances, and 2,041 Candidates have been examined, of whom 98 have passed the Examination for Local Surveyors, and 1,140 that of Inspectors of Nuisances.

The desirability of a Certificate of Competency for Sanitary Inspectors is definitely recognized by at least twenty-seven Sanitary authorities in the metropolis, eighty-three authorities in the provinces, and probably by many others of which the Council are not aware.

The Local Government Board have approved of The Sanitary Institute as a body, whose Certificate that a person has by Examination shown himself competent for the office of Sanitary Inspector under the Public Health (London) Act, 1891, shall be sufficient for the purposes of the requirements of Section 108 (*d*) of that Act.

Two Examinations were held during the year, in conjunction with the Carpenters' Company, in Practical Sanitation and in Building, so far as it relates to Sanitary Construction; forty-two Candidates were examined and thirty-seven were certificated. These two Examinations were preceded by courses of Preparatory Lectures, given at the Carpenters' Hall.

CONGRESS AND EXHIBITION.

The Annual Congress was held at Portsmouth (by the invitation of the Town Council) under the Presidency of Sir Charles A. Cameron, M.D., D.P.H.CAMB., M.R.C.P., F.I.C.

Accommodation was provided for the Meetings, in the Town Hall and other buildings. About 200 Members and Associates of the Institute were present, also 150 holders of Congress Tickets and invited guests. Vol. XIII. of the Transactions will contain a full account of the papers read in the various meetings.

In addition to the regular Sections of Congress which deal with Sanitary Science and Preventive Medicine; Engineering and Architecture; Chemistry, Meteorology and Geology; the following Conferences were arranged, for the purpose of giving those interested in the various branches of Sanitary work an opportunity of discussing Sanitary matters of especial interest to them:—

Medical Officers of Health.

Municipal and County Engineers.

Naval & Military Hygienists.

Ladies on Domestic Hygiene.

Inspectors of Nuisances.

The Exhibition of Sanitary Apparatus and Appliances and Articles of Domestic Use and Economy was held in the new Drill Hall, and was open for twenty-four days. It was attended by 49,000 Visitors. The Judges awarded seventeen Medals and sixty-seven Certificates of Merit. With regard to certain Exhibits, such as Gas Stoves and Fires, Cowls, Water Meters, Pipe-joints, Foods, and other articles requiring special Tests, it is impossible for the Judges to come to a satisfactory decision as to their merits without practical trial, involving special arrangements and investigations in London and elsewhere after the Exhibition; thirty-eight Exhibits of this kind were selected for further practical trial. Demonstrations of Cookery and Dairy-work were given daily at the Exhibition, including the use of Electric Cooking Appliances. A Bacteriological Section was also arranged in a room specially set apart for the purpose, and contained a large collection of apparatus for Cultivating, Examining, Mounting, and Photographing Bacteria. The several processes were shown in all stages of progression, and many specially interesting specimens were lent by well-known authorities.

During the year the Institute has published an Illustrated List of Exhibits to which Medals and Certificates have been awarded, at the Exhibitions held in connection with the Annual Congress. It has been published in the belief that it will be a useful guide to

professional men and to the public in the selection of appliances and articles included in the extensive scope of these Sanitary and Domestic Exhibitions.

PARLIAMENTARY WORK.

Very few Sanitary measures were brought before Parliament during the year, but the Council prepared a number of suggestions on the Sanitary provisions of the Building Law Consolidation Bill, drafted by Mr. Ritchie; owing, however, to the course of public business, this Bill was not introduced to the House. The Council were also invited by the Committee of the House of Commons to give evidence on the Plumbers' Registration Bill, and Sir Douglas Galton, as Chairman of the Council, attended and gave evidence, making various suggestions, several of which were adopted by the Committee.

THE PARKES MUSEUM.

A number of new exhibits have been added to the Museum during the year, and its use by the public and teachers of Hygiene has largely increased.

Classes of Students have been brought to the Museum by the Examiners or Lecturers of several Institutions, including:—

The Architectural Association.
The City and Guilds Central Institute.
The College of State Medicine.
King's College.
The London Hospital.
University College, London.
The Maria Grey Training College.
The (Queen's) Nurses Institute.
The Polytechnic Institute.
The Post Graduate Course.
The Royal College of Surgeons.
The Royal College of Physicians.
The University of London.

Eleven Classes have been brought by private teachers, making 68 classes with a total of 854 students.

The use of the Museum has been granted free of charge to all these Institutions and Classes, and it is also open free to the Public, although the support of the Museum involves an expenditure, out of the funds of the Institute, of about £600 per annum.

The visitors to the Museum during the year numbered altogether 16,575.

CHARTER.

The Council have submitted an application to The Privy Council for a grant of a Royal Charter to the Institute, which is still under consideration.

LIBRARY.

The use of the Library is steadily increasing: during the year there have been 846 readers, as against 546 last year. 310 volumes and pamphlets have been presented to the Library during the year. A list of these will be published in Volume XIII. of the Transactions.

EPITOME OF REGISTERS OF MEMBERS AND ASSOCIATES.

The following table gives the precise changes which have taken place in the various classes of which the Institute is composed during the past year. It will be seen that the number of Honorary Fellows is practically unchanged, and deaths have reduced the Fellows by eight. On the other hand, the number of Members is increased by 60, and that of Associates by 151, so that the aggregate increase is 202.

	Hon. Fellows.	Fellows.	Members.	Associates.	Total.
Dec. 31, 1891	27	154	450	447	1078
Elected	+1	+3	+82	+180	+266
Transferred	..	..	–3	–6	–9
Resigned	..	..	–13	–2	–15
Erased	..	–1	–2	–20	–23
Died	–2	–10	–4	–1	–17
Dec. 31, 1892	26	146	510	598	1280

It is with much regret that the Council have to report the death of:—Prof. Alfonso Corradi and Dr. Hy. J. Bowditch, Hon. Fellows; Prof. Sir Wm. Aitken, M.D., F.R.S., Alfred Carpenter, M.D., M.R.C.S. Sir T. W. Evans, M. Berkeley Hill, M.B., F.R.C.S., John Chas Steele, M.D., John Thompson, M.D., F.R.C.S., J.P., John W. Taylor, M.D., D.SC., J.P., Col. T. Picton Turbeville, W. H. Michael, Q.C., H. J. Marten, M.INST.C.E., Fellows; Right Hon. Earl Bathurst, George Douglas, Thomas Lloyd, John W. Tripe, M.D., M.R.C.S., M.O.H., Members; H. A. Palmer, Associate.

FINANCE.

The Statement of Income and Expenditure for the year shows a considerable increase in the annual revenue, and the growing work

of the Institute has also necessitated a considerable increase in the expenditure. In September the Trustees of the Berridge Estate handed over to the Institute an amount of £9,248 11s. 1d., in Consols, as part of the legacy left by Mr. Richard Berridge, of Ballynahinch Castle, Ireland, for the advancement and propagation of Education in the Economic and Sanitary Sciences. This, of course, greatly increases the financial strength of the Institute and its power for usefulness in the spread of Sanitary Knowledge, and is gratefully acknowledged by the Council.

EPITOME OF THE WORK OF THE INSTITUTE, 1892.

	London Lectures and Examinations.	Total Attendance.
2	Sessional Meetings for the discussion of Sanitary subjects	156
5	Lectures to Ladies on Domestic Hygiene	293
1	Address on Domestic Hygiene..	100
34	Lectures to Sanitary Officers	3,263
1	Examination Local Surveyors	23
2	Examinations Sanitary Inspectors	227
45		4,062

	Provincial Lectures and Examination.	
87	Lectures to Sanitary Officers	7,269
2	Examinations Local Surveyors	12
7	Examinations Sanitary Inspectors	286
96		7,567

	Provincial Congress and Exhibition.	
5	Sectional Meetings	218
5	Conferences	340
3	Lectures	1,380
	Exhibition open for 4 weeks, at which a number of Lectures were given	49,000
		50,938

THOMAS CRAWFORD,
Chairman of Council.

E. WHITE WALLIS, *Secretary.*
22nd February, 1893.

STATEMENT of INCOME and EXPENDITURE for the Year ended 31st December, 1892.

Dr.

Expenditure.	£ s. d.	£ s. d.
To Transactions, Cost of Printing, &c., less Sales and Advertisements—estimated		171 17 2
,, Sessional Meetings	7 5 6	
,, Lectures, Sanitary Officers	317 15 6	
,, ,, Domestic Hygiene	51 18 0	
,, Examinations of the Institute	1,280 15 11	
,, ,, in connection with the Carpenters' Company	144 7 5	
,, Illustrated List of Awards at Exhibitions	110 1 4	
,, Congress—General Expenses	232 9 0	
		2,144 12 8
,, Rent, Rates, Taxes, and Insurance	266 19 6	
,, Salaries and Wages	685 5 0	
,, Coals and Care of Offices	37 16 10	
,, Repairs and Alterations	28 17 1	
,, Library, Binding, &c.	8 6 0	
,, Postage and Carriage	75 13 9	
,, Printing and Stationery	97 2 3	
,, Advertising	9 16 6	
,, Incidental Expenses	81 7 7	
,, Law Charges	23 3 8	
,, Office Furniture	7 3 5	
,, Depreciation of Leasehold	50 0 0	
		1,371 11 7
		3,688 1 5
,, Balance for the year 1892		324 15 4
		£4,012 16 9
,, Balance to be carried forward		£11,434 15 10

Cr.

Income.	£ s. d.	£ s. d.
By Annual Subscriptions	830 0 6	
,, Entrance Fees	100 16 0	
,, Life Compositions	21 0 0	
,, Fellowship Fees	10 10 0	
,, Donations	4 4 0	
		966 10 6
,, Illustrated List of Awards at Exhibitions	82 1 3	
,, Lectures, Sanitary Officers	574 12 9	
,, ,, Domestic Hygiene	24 4 3	
,, Examinations of the Institute	1,777 7 8	
,, ,, in connection with the Carpenters' Company	162 15 0	
,, Publications — Farr's and Simon's — Profit on Sales	6 11 10	
,, Interest on Deposit	6 6 4	
,, Congress—Sale of Tickets, &c.	36 4 0	
,, Balance from Exhibition account	376 3 2	
		3,046 6 3
		£4,012 16 9
,, Balance brought forward from last account		2,110 0 6
,, Legacy from Berridge Estate— (£9,248 11s. 1d. Consolidated Stock) valued at		9,000 0 0
,, Balance carried forward on Year 1892		324 15 4
		£11,434 15 10

Examined and approved, Alfred Lass, Wood & Co., Chartered Accountants, Magnus Ohren, Assoc.M.Inst.C.E., } *Auditors.*

February 25*th*, 1893.

STATEMENT OF INCOME AND EXPENDITURE connected with Exhibition at Portsmouth, 1892.

Dr.

Expenditure.	£	s.	d.
To Printing and Advertising	307	18	5
,, Catalogues and Programmes	123	1	8
,, Bands and Entertainments	237	12	0
,, Lectures	39	9	11
,, Curator's Salary and Expenses	186	13	3
,, Wages	187	14	11
,, Incidental Expenses	94	13	7
,, Buildings, Fittings and Decorations	151	17	6
,, Judging Expenses (Partly Estimated)	210	14	8
,, Grounds	194	2	1
	1,733	18	0
,, Balance	376	3	2
	£2,110	1	2

Cr.

Income.	£	s.	d.
By Rent for Space	973	19	6
,, Admissions	847	9	3
,, Catalogues and Programmes	221	2	9
,, Fees for further Trials	19	9	8
,, Grounds	48	0	0
	£2,110	1	2

Examined and approved,

ALFRED LASS, WOOD & Co., Chartered Accountants,
MAGNUS OHREN, Assoc.M.Inst.C.E., } *Auditors.*

February 25th, 1893.

GENERAL BALANCE SHEET, 31st DECEMBER, 1892.

Liabilities.	£	s.	d.
To Subscriptions paid in advance for 1893	48	6	0
,, Examination Fees ,, ,,	27	16	6
,, Exhibition Account	41	13	0
,, Museum Arrangement Account	11	2	5
,, Sundry Creditors	633	9	3
	762	7	2
,, Balance of Assets over Liabilities	11,434	15	10
	£12,197	3	0

Assets.	£	s.	d.	£	s.	d.
By Lease of Premises, 8 years unexpired	394	3	8			
,, Library and Contents of Museum, estimated value	500	0	0			
,, Furniture and Fixtures, estimated value	100	0	0			
,, Transactions and Publications, estimated value	545	2	6			
,, Farr's Works, estimated value	29	12	6			
,, Simon's ,, ,,	100	10	0	1,669	8	8
,, Sundry Debtors—						
Members' Subscriptions and Arrears	149	2	0			
,, ,, from old Societies	12	12	0			
Fellowship Fees	5	5	0			
Entrance Fees	50	8	0			
Expenses *re* Charter in suspense	63	14	3			
Amount due on account of Congress and Provincial Lectures	124	8	6			
Exhibition Account	11	10	0			
				416	19	9
,, Cash at Bankers on Current Account	632	1	8			
,, ,, ,, on Deposit	500	0	0			
	1,132	1	8			
less Petty Cash overdrawn	21	7	1			
	1,110	14	7			
,, Investment (£9,248 11s. 1d. Consolidated Stock) valued at	9,000	0	0	10,110	14	7
				£12,197	3	0

Examined and approved, Alfred Lass, Wood & Co., Chartered Accountants, Magnus Ohren, Assoc.M.Inst.C.E., } *Auditors.*

February 25th, 1893.

DISPOSAL OF HOUSE & TOWN REFUSE.

By Charles Jones, M.Inst.C.E., F.S.I.

Read at Sessional Meeting, February 10*th*, 1892.

It has been my privilege on previous occasions to read before this Institute various papers dealing with the above, and as probably many of you either heard me on those occasions or read the printed papers, it will be unnecessary to make any lengthy introductory remarks upon the importance of this subject, and the difficulties which Vestries and other public bodies have found in dealing, in a satisfactory manner, with the large quantity of material which comes under the heading of "House and Town Refuse."

Town refuse, as referred to in this paper, includes not only the contents of ashpits and dustbins, but also the large quantities of refuse from businesses and trades, and sweepings of the streets—products which formerly could be dealt with in various ways; but now the large increase in building operations and the population, entirely prohibit public bodies from dealing with the question in the old methods, which will not be introduced into my paper to-night.

Material which at one time could be disposed of at a small cost, and in some instances at a profit, for the purposes of agriculture, and in the manufacture of bricks, cannot now be so dealt with. Hence, day by day we see that the question is becoming of more importance, and a source of greater difficulty.

What we have to consider is how to deal with the difficulty under *existing* circumstances, the great principle being to dispose of the material as *rapidly* as circumstances will permit, and *in the most sanitary and economical manner.*

Various methods of separation and mixing, in order to make the material saleable, have been tried, but practice shows the cost rarely falls below the realisable value, and generally far exceeds

it; leading us to the conclusion that the most truly economical method is to get rid of it as it is received, and *with as little handling as possible.* It was only natural, therefore, to fall back upon that which has been, and we presume will ever be, the great natural agent of purification, viz., "fire."

Generally speaking, dustbins contain a large proportion of combustible material in the form of cinders and unburnt coal (varying, of course, according to the locality from which the refuse is taken), and we are thus provided with the necessary fuel for raising the heat to destroy the material of a less combustible nature comprised in towns' refuse. It is many years since attempts were first made to deal with the refuse in this way. Furnaces were constructed, but in a very crude manner, failing to answer the purpose for which they were intended, but leading many inventors to devote considerable attention to the subject, and to deal with it in a scientific way by constructing furnaces to utilize to the best advantage the combustible portion contained in the refuse. I will not stop to describe the various types of furnaces, but will merely state that, generally speaking, they were bad; the shape and construction of the fire-brick arches were wrong, the arrangements for feeding were unsatisfactory, and the flues and passages for gases were designed more by guess-work than by calculation. It is therefore no wonder that these proved only feeble attempts to introduce the principle of fire, it being found necessary to burn coal and other fuel in order to dispose of the refuse collected.

In the year 1876 experiments were made by Mr. Fryer, of the firm of Manlove, Alliot, and Fryer, who constructed a furnace which he named the "Destructor." He was fortunate in inducing the Nottingham Corporation to give it a trial, and it is needless to say that it turned out sufficiently successful to warrant them extending the experiments, and in a very short time three of these Destructors were built and at work upon Fryer's principle.

I will explain, for the benefit of those present who may not be familiar with the construction of the apparatus, that the cells are constructed with an internal arrangement of the flues, feeding hoppers, furnace doors, and firebars. The disposition of the cells, either side by side or back to back, is simply a matter dependent upon the site and the convenience of the situation. Each cell constitutes a separate furnace, consisting of a cavity enclosed by a reverberatory arch lined with firebricks. It is supplied with a hearth for the reception of the material to be consumed, from which it passes into the furnace proper. The firebars are placed in a slanting position, in order to favour the

passage of the material to the front, and so facilitate the removal of the clinkers. The top of the Destructor forms a perfect platform, having an opening over each cell into which the refuse to be burnt is shot from the collecting carts. The opening for the entry of refuse is divided from the opening for the exit of gases by a wall, and a bridge is built to prevent refuse which is heaped on at each charge from getting into the flue immediately below. Cells are provided with special openings for the introduction of infectious mattresses, diseased meat, dead cats and dogs, which fall direct upon the red burning mass, and are there consumed without nuisance.

Many other inventions of minor importance have been brought out, but they are not sufficiently to the fore for me to trouble you with the various details connected with them. It will be sufficient for our purpose to give a description of one of the latest which has attracted considerable attention, viz., the Destructor which has been named the "Perfectus," of which Mr. Warner, of the firm of Goddard, Massey and Warner, is the patentee.

This has been adopted in several towns. It may be described as consisting, generally speaking, of a block of brickwork 34 ft. wide by 30 ft. long, by 10 ft. 6 in. high, strengthened on the front of each furnace with heavy segmental cast iron facia plates to protect the brickwork, having sliding rails to support the furnace doors, with baffle plates of special construction, so that the fires may be examined quickly without allowing the admission of cold air. The ashpits are the same width as the furnace arches, and their front parts are also covered with iron-work, having sliding doors, so that they may be closed if necessary and the air regulated or the fires be blown up by means of a large blower, which forms part of the plant erected over the top of each furnace. There are two dampers worked from long wrought iron spindles, and balanced on the outside of the furnaces. These dampers are closed each time the men "clinker," and each time they draw down fresh refuse to be burnt, so that the furnaces are kept very hot. Internally the block of brick-work contains six reverberatory fire brick arches 5 ft. by about 10 ft. One half of the arch is made to cover a special drying hearth, upon which the refuse is prepared for actual combustion. The other half of the arch covers the fire grate, which is made wholly of wrought iron, supported upon strong bearers. The structure is tied together by wrought iron tie-rods at the back and front, supported by channel irons, and at the ends by massive cast iron back stays. Over each damper a vertical flue is constructed, terminating in the main flue leading to the cremator, and is covered by a cast iron frame and cover to allow a passage

for workmen for cleaning. The top of the furnace forms a level platform, upon which the refuse is tipped from the carts as delivered, and is paved with blue Staffordshire bricks on cement. Each furnace has an opening or hopper capable of holding about the third of a cartload of refuse, and the contents of this hopper are discharged by means of a wrought iron lever projecting through the furnace roof; there are two doors at the end of the main flue for taking out fine dust, and there are special pockets at various distances, provided with frames and covers for cleaning purposes while the Destructor is in operation.

The refuse when removed from the house is now almost invariably conveyed to the depôt in covered carts or waggons, so as to avoid the nuisance of the fine dust, paper, &c., being blown about the streets by the wind, to hide the material from sight, and to prevent the dissemination of offensive smells and the diffusion of disease germs. On arriving at the depôt, the vans are drawn up an inclined roadway to the tops of the Destructors, where they are tipped against a beam. It is necessary that the larger tins and old iron utensils should be picked out before it is fed into the furnaces, and in some instances it may be advisable to pick out the bottles, which can be readily sold. The material is then fed into the feed-holes—before referred to—on to the sloping hearth, drawn forward by the stokers on the ground level with long iron rakes; and having been properly raked down and evenly spread over the fire-bars, the furnace door is closed and the contents of the cell are allowed to burn for a period varying from one and half to two hours, it not being advisable to draw the fires more frequently than this, as the destruction of the material would not be perfect. At the expiration of the time mentioned, the furnace door is opened and the fires drawn, the contents of the cell having been reduced to a hard clinker, which comes out in large cakes. During the burning a certain proportion of fine ashes falls through the fire-bars, and would be likely to cause inconvenience and danger to the stoker by being blown about. In order to avoid this I have designed a pit, of concave form, under the fire-bars, to hold water, into which the dust will fall, and can be removed in a damp state when the fires are drawn. It being most essential that the high temperature in the dust-chamber should be maintained, it is very desirable that the fires should be kept going both night and day, and an arrangement made, so that during the feeding and clinkering, when the mouth of the furnace is open, the admission of cold air into the dust-chamber tending to lower the temperature, should be reduced as much as possible. This is done by means of a cast-iron hinged door over the opening entering the dust-

chamber, attached by a chain to the *furnace door*, and is so arranged that whenever the furnace door is open the entrance to the dust-chamber is about four-fifths of its area closed, and when the furnace door is shut the flue door is open. This arrangement is entirely automatic, and quite independent of the attention of the stokers. The residuum from the fires—a hard clinker and fine ashes—amounts to about 25 per cent. of the quantity fed into the furnaces, and may be utilised in many ways. It is an excellent material for foundations of roads; when broken, for concrete, tar-paving, &c.; or when ground in a mill, is unequalled for mortar for building purposes. Thus the house refuse has not only been transformed from a filthy and deleterious mixture into a material at once inoffensive and useful, but during the process a most valuable property has been developed, viz.. immense steam-producing power, the utilisation of which will considerably reduce the cost of disposal.

The establishment of these Destructors has met with so much opposition in many towns as to be almost incredible, and; no doubt in their primary condition there were defects, but even then they were as nothing compared to the injury to health, so successfully obviated by the rapid destruction of tons upon tons of objectionable matter, which had to be got rid of in some way. Formerly the vapours and gases given off in the drying of the material, and the first stage of burning, before it got well into the fire, were perceptible, as were also the fine dust, unburnt paper, &c., which escaped from the shaft. But these are now things of the past, and the fact that Destructors are in full and successful operation in the very heart of London, numerous large towns, and in our fashionable residential suburbs, goes to prove beyond a doubt that a Destructor, if properly worked, may be used anywhere and everywhere without the slightest fear of any complaint, other than a sentimental one, arising in connection with it. I may mention that a Destructor has been in working order for some eight years in Ealing, adjacent to high class residential property; that is to say, within 380 yards are houses of a rateable value ranging from £120 to £330; within 183 yards are two Isolation Hospitals, erected not only under the approval of the Medical Officers of Health to the Local Authorities, but with the approval of the Medical Advisers to the Local Government Board; and within a distance of 600 yards, there are a Convent and a large Military College, not to speak of the 100 to 150 houses of smaller rateable value, which have sprung up all around it; and Dr. Thomas Stevenson, one of the Royal Commission of which Lord Bramwell was the head, and Lecturer on Chemistry at Guy's Hospital, states: "That if a Fryer's Destructor, with Fume Cremator, was erected,

it would not be possible to affect the health of the surrounding population, and so cause the slightest nuisance of any kind or description."

How to avoid the nuisance from the vapours, gases, fine dust, charred paper, &c., to which I have referred, engaged attention for some time, and various experiments to meet these difficulties, ultimately resulted in the simple construction known as the "Fume Cremator." This simple apparatus is built in such a position between the furnaces and the chimney shaft that all the products of combustion are bound to pass through it before reaching the shaft. It consists of a reverberatory arch, with rings of fire-bricks placed in the direction of the gases. Ribs of fire-brick projecting from the arch serve to deflect the gases, and to direct them on to the top of the red-hot mass of fire. The heat in the Cremator, which varies from 1,000 to 1,500 degrees F. is maintained by fine coke breeze, or ashes screened from the refuse, fed in at the top, and an arrangement made by which fresh air is supplied beneath the fire-bars, to assist combustion and dilute the vapours as they pass into the Cremator. As a proof of the efficacy of this contrivance, I may mention that at Ealing not only is the house refuse treated in the Destructor, but far more offensive material, viz., sewage sludge, is disposed of without the slightest nuisance being caused.

A material which is also a source of considerable difficulty to dispose of, especially in our large towns, is the slop or slurry, which is taken up from the roads. This slop, which contains a large amount of organic matter, when mixed with the house refuse, can be effectually dealt with in the Destructor; the ingredients which it contains making the clinker a more valuable material for building purposes, owing to there being a large proportion of Silica with it.

From returns made we find that some fifty towns have adopted the Destructor, of which twenty-four have in conjunction with the Destructor adopted the "Fume Cremator," and almost without exception the reports as to its use are most satisfactory; and, quoting from a report to the Highways and Sewage Committee of the Corporation of Hyde, embodied in the annual report of one of our best known suburban districts, it is stated with reference to the Destructor erected in the latter district:—"Adjoining the furnaces, and in a line with the chimney, a Cremator is constructed, consisting of a furnace which completely consumes the gases, and prevents any large quantity of smoke issuing from the chimney." It may be mentioned that at Ealing for the year 1891 the average weekly cost of coke breeze was £1 16s. for seven cells, and did we not require the cinders contained in the house refuse for burning the

sewage sludge, we should adopt the system carried out at Hampstead, Leicester, Langston, &c., using screened cinders for feeding the Cremator. At Hampstead, where there are eight cells, the cost of "Fume Cremator" is 25s. per week.

Upon this part of the subject, I will conclude with an extract from a report of F. M. Rimmington, Esq., F.C.S., to the Corporation of Bradford.

BOROUGH OF BRADFORD.

Extract from the Report of F. M. Rimmington, Esq., F.C.S., October, 1889.

To the Chairman of the Sanitary Committee.

In accordance with your instructions I have made four visits to the Destructors in Hammerton Street, two visits before the Fume Cremators were in operation and two since. Friday, October 11th, 1889.—The Cremators having now been in use more than a fortnight, and therefore considered in perfect working condition, I again visited the works and made similar tests to those made on similar visits, the result in every instance indicating a decided improvement in every particular. The smell of the escaping vapours is of the first importance as far as the public is concerned, and this objection is now almost annihilated; only an almost imperceptible taint is present. Several experiments were continued for more than half an hour, passing through solutions intended to arrest any compound of sulphur, ammonia, or organic matter, with almost negative results; even the watery vapour from the steam jets appears to be decomposed, for only $5\frac{1}{2}$ grains of water were obtained from one cubic foot ($6\frac{1}{4}$ gallons) of the vapour. This almost goes to prove that every compound is decomposed and reduced to its ultimate elements. Wednesday, October 16th, 1889.—The experiments on this occasion were the same as on the 11th inst., only carried on for a longer time. The smell of the vapour was exceedingly slight and difficult to describe: the amount of organic vapour even less than before, almost *nil* in fact. Ammonia, or any salts of ammonia, were quite absent, and 0·19 grains of sulphuric acid in one cubic foot. A kitchen fire would yield much more than this. The effect of the gases from the furnaces passing through the Cremators appears to be that all compounds are decomposed, and scarcely a vestige of any that can be construed to be offensive or obnoxious escapes, and in my opinion the result is as nearly perfect as it can be.

(Signed) F. M. RIMMINGTON, F.C.S.,
Borough Analyst.

I will now refer to the steam-creating power generated in the furnaces, and which may be used in many ways, according to the position and requirements of the district.

At Southampton the heat is utilised in connection with pumping-machinery, the working of ejectors, the driving of a

dynamo, the generating of electricity, and for working the machinery in use at the Sanitary Works, &c. At Hastings it is used for pumping sea water, and in the Ealing district, which I represent, it is used for working the machinery for pumping, for working the clinker-breaking machine, and grinding mill. Now that the adoption of the electric light for illumination by public bodies is coming so much to the fore, the steam power could be most advantageously utilised, and the process which has been described in this paper would enable us to not only dispose of slurry, house refuse, and other material, which is frequently a source of nuisance and heavy expense, but the cost would be reduced to a minimum as compared with other systems of disposal.

The average quantity of refuse destroyed per cell in twenty-four hours may be taken at six tons, and the number of men working six cells, two by day and two by night. In the Ealing district, where the material dealt with is a mixture of sewage sludge and house refuse, containing a large proportion of moisture, there are three men by day and two by night to work seven cells and Cremator; the quantity of material destroyed per cell in twenty-four hours is five tons, and the *gross* cost, including repayment of capital, labour, and Cremating Fumes, is 1s. 2¼d. per ton, which is, after deducting prime cost, repayment, the value of steam-power, clinker, &c., reduced to 3½d. per ton.

To those who carefully study the subject there cannot be two opinions as to the value of this now well-established apparatus. The question of site we cannot but feel is absolutely disposed of, and the sentimental feeling which has so long stood in the way of its more general adoption is dying out. The testimony borne by such men as Drs. Stevenson and Tidy and Professor Wanklyn, together with other well-known scientists, and the men who have the practical working of the same, is sufficient, we think, to settle not only the question of its value, but its absolute freedom from inconvenience and annoyance to surrounding property; and, taken with the proved economical working and results, we feel that every town in England will claim the right to erect and use a Destructor as the best means of disposing of in a sanitary, effectual, and economical manner, a material which has, and is, causing so much difficulty and annoyance.

[*For discussion on this paper see page* 56].

HOUSE DUST REFUSE.

By Mr. Joseph Russell.

Sessional Meeting, February 10*th*, 1892.

The refuse of towns may be divided under three heads—

House Refuse.
Trade Refuse.
Street Refuse.

In some places these have been and still are dealt with under one and the same system. In other places they are dealt with separately, as should be the case.

It is to a new mode of dealing with the first of these I wish to call your attention, but if the same principles were applied to the two others mentioned, satisfactory results would be obtained.

House dust refuse in the past, when shot on waste land or vacant spaces, was formerly picked over by the poorest class of the population, and the products used or sold, but when a value in the products came to be recognised, the contracting dustman employed persons to sift and sort by hand; and to the present day, in some of the dustyards, women may be seen buried to their waists in the dust that falls through the hand sieve from which they shake and pick over the dust.

As an improvement upon this most insanitary process, the Destructor, so called, has been introduced, and were all the products of the dust-bin combustible they could have been disposed of by this method, but even some of the material which is combustible, leaves an ash of such a character, that it is almost impervious to heat and air, and so hinders the combustion of material above and around it. Many products are incombustible, whilst others, such as animal and vegetable matter, cannot be destroyed by fire without giving forth vapours full of odour of an unpleasant nature, and as much of this material is already commencing to decompose, and in some cases is in an advanced state of decomposition, the vapours and gases cannot be of the most healthful character. The material that is combustible

during the process of burning, alters to a certain extent the character of the incombustible material, but so slightly, as to render this product of little value, and the residue of the heat is wasted, or where used for generating steam the result obtained is very trifling in comparison with the quantity of combustible material used.

Utilization to the fullest extent is the correct principle to apply.

Starting on this principle of utilization, it is advisable first of all to look carefully at what has to be dealt with, and although the dust-bin contains almost everything under the sun in a heterogeneous state, yet there are different kinds or classes of material that predominate, under one of which, any and every article may be placed and dealt with. After five years' experience dividing and weighing a large quantity of material, at various seasons of the year, the following are the principal constituents and average proportions in 1,000 tons.

Average Weight per Load .... 19 cwts. 0 qrs. 20 lbs. nett.

Component Parts.	Average per Load.			Average per 1000 Loads.			
	Cwts.	Qrs.	Lbs.	Tons.	Cwts.	Qrs.	Lbs.
Crockery	„	„	11¾	5	5	0	0
Iron	„	„	4½	2	0	0	20
Tins	„	„	17	7	11	2	22
Mixed Broken Glass	„	„	10¼	4	11	2	2
Bottles	No. 5.			5,000			
Straw and Fibrous Material	„	2	13¼	30	18	1	6
Waste Paper	„	3	8	41	1	1	20
Rags	„	„	8½	3	15	3	16
Coal and Coke	„	„	18	8	0	2	14
Breeze (Cinders) and Ashes	12	0	25	611	3	0	4
Fine Dust	3	2	27	187	1	0	8
Vegetable, Animal and Mineral (ground for manure)	„	3	15	44	3	3	20
Bones	„	„	10⅓	4	12	1	1

These figures are corroborated very nearly by Thomas Codrington, Esq., Engineering Inspector to the Local Government Board, in his report upon the destruction of Town Refuse. There are, therefore, about thirteen classes of material for the dust to be divided into, and to accomplish this, as it must necessarily be on a large scale and on sanitary principles, a scheme has been elaborated, after several years' patient working, by which nine-tenths of the material is sorted without touching by hand, and the remaining one-tenth only after it has been well dusted and cleansed. This is accomplished (and can be seen at the works of the Refuse Disposal Company, Salopian Wharf, Lots Road, Chelsea) by a series of cylindrical screens

with meshes 12 ins. by 3 down to $\frac{1}{8}$ in. square, gravitating-shoots, air-blast, travelling sorting-tables, &c., of which the following is a general description:—

The dust-cart tips the contents into a large revolving cylinder 10 ft. diameter and 12 ft. in length. This screen is fitted with hard wood bars so as to prevent bottles being broken, the spaces between being 12 in. in length and 3 in. wide so as to retain large bottles, &c. The material which is retained in the cylinder is guided by a coarse wood worm so as to ensure that the material shall be retained in the screen a sufficient time to remove all dust and small objects. Large paper, rags, carpets, wood, mill and straw board, boxes, bottles, tins, boots, straw, and other large articles are sorted as delivered, either at the end of the screen or on a travelling table, each article being put into its own class or bin. The material which passes through the mesh of the screen is elevated into a second screen fitted with a spiral worm, so that all the material has to pass over a surface of about 270 ft. in length on a mesh $1\frac{3}{8}$ in. square, and falling from the cylinder is met by a blast of wind which drives all paper into a special cage or cupboard. The material which falls through the blast is directed on to a continuously revolving iron table and is distributed in a thin layer of material, so that each article can be at once picked up and put into its own place. All vegetable and animal matter are left upon the table and are deposited upon the ground by the grinding mill. The principal products sorted from the table are bones, large coal and coke, metals, glass and crockery.

The material which falls through the $1\frac{3}{8}$ in. mesh of this No. 2 screen, is delivered into a third screen, which is fitted with two different sized wires, viz., $\frac{1}{2}$ in. square mesh, and $\frac{3}{8}$ in. square mesh; also an outer or fourth screen with $\frac{1}{8}$ in. mesh. The material that comes from the end of these screens, and also that through the $\frac{1}{2}$ in. mesh forms what the brickmakers call breeze, and is used for burning bricks. That which passes through the $\frac{3}{8}$ in. mesh is called ashes and is mixed with the clay that is formed into the brick. This material also forms the fuel for the boilers, to provide steam for the works; and although at first great difficulty was experienced to maintain steam, yet since the introduction of a patent steel fire bar, with a forced draught, this trouble has been entirely overcome and there is not the slightest difficulty in maintaining the steam pressure required. It has also been found that on account of the very small surface of bar in contact with the fuel, and the very large volume of air in numerous and fine streams and that also heated, the combustion is practically perfect. Another great advantage is also obtained, the clinker

(of which there is about 30 per cent.) does not adhere to the fire-bars, and can be removed with the greatest ease. The products of combustion can be finally passed through scrubbers before discharging them into the air.

A load, or ton, from the time it is shot from the cart will pass through and be sorted into its various places in from five to seven minutes.

One very important feature and to which I would call your attention is the means by which it is made a perfectly healthy and sanitary occupation. The first screen into which the dust cart delivers its contents is provided with a very powerful exhaust fan, which extracts 7,000 cubic feet of air per minute, drawing in any odour and all particles of dust that rise in the screen, and discharges these into closed ashpits under the boiler fires, so providing the forced draught, and at the same time burning the dust and vapours. At various points inlets from other screens and dust chambers are taken into the main tube, so that "it prevents injury to the dust sorters, and the atmosphere in which the operations take place is kept pure."

Having given a general description of the process, it will be well to point out the uses to which the 13 classes of material can be put—

Paper and rags are made into a common brown paper or leather board.

Straw and fibrous material and small pieces of paper for straw boards.

Woollen rags are sold for shoddy.

Large coal and coke, sold.

Iron, sold.

Bottles are sold for re-use, &c.

Crockery has been sold for re-manufacture. Offers have also been made for it, if broken up and sorted into sizes, for use in tar paving instead of marble chips.

Ashes and breeze into block fuel for steam purposes, or for electric lighting, or for brickmakers.

The vegetable and animal substance with the fine dust and the bones for agricultural purposes, or as a basis for distributing strongly concentrated manure (such as nitrate of soda).

Mineral, such as the clinkers, stones, &c., for concrete blocks or artificial paving stones.

The clinkers being very hard are also suitable for mortar, or to use in lieu of sand on wood and other roads.

Broken glass can be remade into bottles, &c., or used for making glass-paper, or as a flux.

Tins, these by a simple process can be cleansed from the fats adhering to them, and the solder run off and collected, whilst the plates are melted and run into sash weights or slabs; or the plates can be bundled up and sent to the mills to be re-forged.

There is, therefore, not only a use for every portion of the house dust, but when so divided and dealt with, these products possess a commercial value, and will pay all the expenses of manufacture and leave a handsome profit on the outlay.

Looking at all other modes of disposal, whether shoots, barging away, carrying to sea, or the Destructor, not one can compare, as all of these even according to the most sanguine reports and low estimates, are acknowledged to be carried out at a loss, and in most, if not all cases, the loss is very great.

Another very great economy can be effected by this system of utilisation—that is the cartage. These works can be placed at any convenient position in a town or parish, as the works can be conducted without the slightest nuisance to the neighbourhood, this having been practically proved by the Refuse Disposal Company having, even with the incomplete experimental works at Chelsea, carried them on for nearly five years, although closely watched for months by persons specially paid to do so, and by neighbours opposed to the works being placed in Lots Road. The Company have only once been summoned before a magistrate, and the case was adjourned and then dismissed, the nuisance being only the result of an accident.

That there is no nuisance is also amply confirmed by the fact that three Vestries, viz., Kensington, Westminster, and Chelsea, are daily delivering portions of their dust.

The question now arises are Vestries or Corporations to put up these works? Do their powers only permit them to spend the ratepayers' money, or can they carry on a trading process to save the ratepayers' money? That is a question they can answer; but it is my opinion that before very long we shall find the commercial world will take up the Company's process as a business of a very profitable character.

[*This discussion applies to the two preceding papers by* Charles Jones *and* Joseph Russell.]

Mr. C. H. Lowe (Hampstead) thought that if all that Mr. Russell had described could be carried out, it would be a happy time for Vestries, but he had not any personal knowledge of the process. In Hampstead, after deliberating on the question of providing a Destructor for three years, they selected a site at some distance from

their district. The cost of removal and disposal of house refuse in Hampstead amounted to about eleven shillings per house per annum, or 6s. a ton. He thought that, although it was possible to realize something from the waste products by a process such as Mr. Russell had described, there would always be the cost of collection. This in Hampstead amounted to about £6,000; the carts being able to collect and deliver at the Destructor two loads per day. The Destructor in Hampstead consisted of eight cells, and cost about twenty-five shillings a day for working. The total cost of the Destructor was: £2,457 for land; building, £4,500; total, £6,957. The residuum from the Destructor was about 25 per cent., 16·5 clinker, 8·5 fine ash.

Mr. F. D. Askey (Hornsey) did not favour the now general idea of rendering noxious matters innocuous by means of fire. He thought that waste products should, as far as possible, be returned to the soil, or otherwise utilised. He hoped that Mr. Russell's process might be found practicable for general application. With regard to the Destructor at Hornsey, they had a Fume Cremator added to it, but did not find it necessary to use it so long as the firing of the furnace was carefully attended to. The chimney of the Destructor was 217 feet high. The cost of using the Cremator came to about £800 a year, as they found it necessary to use coke for firing. They had tried the use of coke breeze, but it caused large volumes of smoke.

Mr. Alliott (Nottingham) thought it was an interesting question to what extent Mr. Russell's process was likely to pay; and there was another important question—supposing it to pay, was it desirable from a sanitary point of view? As the whole process consisted practically in sorting there was nothing that would destroy germs of disease that might be accumulated in the refuse. It was well known that all sorts of things find their way into dust receptacles, and although they cause no evil at the works may carry it elsewhere. That the Destructor is becoming more popular is shown by the fact, that during 1891 the number of new cells erected had added about 50 per cent. to the number of those already in use. With regard to the cost of using the Destructor at Hornsey, he thought that if they were unable to burn anything but large coke it was probably due to a want of knowledge of how to use the apparatus. At Leicester the cost of working the Destructor was 8d. per ton of refuse less the returns for by-products and steam power. If nitrogenous matter is to be returned to the soil, this would be effected to a much larger degree by adopting the pail system for the disposal of fœcal matter, than by any method of dealing with ashes and other house refuse.

Mr. C. H. Cooper, Assoc.M.Inst.C.E. (Wimbledon) said they were all interested in the experimental process being carried out by Mr. Russell at Chelsea. He wondered that the farms on London clay had not made more use of ash refuse for mixing with the soil.

The Wimbledon sewage farm had been greatly improved by trenching in house refuse. He did not see how they managed to cremate refuse at anything like 10d. per ton, taking into account the cost of labour and plant necessary. It had been suggested that house sewage could be mixed with the dust refuse, and burnt in the Destructors; but it was almost impossible to store this mixture without nuisance while it was waiting to be cremated.

The Chairman, Sir THOMAS CRAWFORD (Blackheath) thought that everyone would be struck by the products that Mr. Russell had been able to obtain from house refuse. There appeared to be two processes under discussion for dealing with this matter—cremation, and sorting and utilising. Hardly anything had been said during the discussion about the removal. This was important from a sanitary point of view, and was very bad in his own district. It was essential that this question should be dealt with before it came to the question of disposal. His sympathies were in favour of destruction by fire, from a health point of view, but he could not but approve of the efforts made for utilising these products.

Mr. J. RUSSELL (Chelsea) said that he did not think he had exaggerated in describing the products obtained from house refuse. People were glad to use the block-fuel made at the works, and he gave results of some tests as to its value. He saw no reason why house refuse should not be collected daily, the receptacles being taken away and fresh ones left; this would get rid of many evils now arising from house refuse.

Mr. C. JONES, M.Inst.C.E. (Ealing), said that he had visited the Separation Works at Chelsea, and was delighted to see the way in which every scrap was utilized. He thought it was wonderful how they managed to deal with so much material in so small a place, and the whole arrangement was so very creditable. With regard to the cost of working a Cremator he well knew that it might be made to spend a lot of money. At Ealing they had seven cells at work, costing only £1 16s. a week. They made a good use of the assets, and the final cost was 3½d. per ton of refuse dealt with.

THE AIR AND WATER OF LONDON: ARE THEY DETERIORATING?

By Louis C. Parkes, M.D., D.P.H.Lond.Univ., Lecturer on Public Health at St. George's Hospital, Medical Officer of Health and Public Analyst for Chelsea.

Read at a Sessional Meeting, March 9th, 1892.

From time to time, to those who are of a reflective turn of mind, and more especially to Medical Officers of Health who are so intimately acquainted with Public Health questions, the question suggests itself—is London a better place to live in, as regards health and comfort, than it was half a century or so ago? Those who are acquainted with the past and present conditions of life of the mass of the population, would answer largely in the affirmative, but nevertheless with certain reservations. There can be no question that the majority of the population is far better housed now than at any previous time in the history of London. Slums and rookeries have to a considerable extent disappeared; improved houses, and working-class dwellings of substantial character have been erected; streets have been widened; open spaces have been secured; and all classes have benefited enormously by the growth of practical sanitary knowledge in drainage, house sanitary arrangements, and sewerage. A public health service, on the whole of a very efficient kind, has grown up in London, and sanitation is now enforced in a way which 50 years ago would have appeared almost incredible.

Vast improvements, then, have been effected; and we see the results of the improvements in a lowered general death-rate, and in a greatly diminished morality from small-pox, scarlet fever, typhus, typhoid fever, and diarrhœa—diseases of the zymotic class usually said to be preventable. For instance, during the five years, 1886-90, the death-rate from small-pox in London was only one per million, as against 402 per million in 1841-50; during the ten years, 1881-90, the death-rate from scarlet-fever was 333 per million as against 1133 per million in 1861-70; during the same decennium the death-rate from

fever (typhus, enteric, and continued fever), was 205 per million as against 979 per million in 1841-50; and the death-rate from diarrhœa in 1881-90 was 749 per million as against 1030 per million in 1851-60. Virulent cholera has been practically extinguished during the past 20 years in London and in the country generally.

It is true that sanitary improvements have had little or no effect in lowering the mortality from measles and whooping cough—these being diseases of early childhood, over which it is extremely difficult to exercise any effectual public control. It is also true that diphtheria has shown a notable increase, and caused a heavy mortality in London during the past ten years, the death-rate for 1881-90 being 259 per million, as against only 122 per million in the preceding decennium, but this is no doubt the price we have to pay for our system of compulsory elementary education, which causes the aggregation of such large numbers of children in confined spaces.

During the past two years, also, influenza has been with us, and has raised the death-rate by some 2,000 per million during its visitations. We can at present only plead want of knowledge of how to exercise control over this disease in its epidemic form. It is certain that the ordinary methods of notification, isolation, and disinfection are—even if they were put in force—powerless to arrest the spread of the epidemic. They have not been put in force up to the present, however; and we are forced to be content with a policy of inactivity, whilst we watch the ravages of a communicable malady, a policy which furnishes a curious commentary on the limitations of human knowledge at the end of the nineteenth century.

With all its modern sanitary improvements, however, one, if not two, of the most vital factors of life in London, is undergoing steady, continuous degeneration. I allude to the air of London, and in a less degree to the water of London.

The degeneration of the air is due to the continuous growth of the town, which year by year removes the centre of the city further and further away from the country, and to the steady increase of smoke from coal fires poured into the atmosphere. It is a curious and interesting fact that London is dependent, one might say, almost for its life, upon the winds which bring pure air to it from the country. It is very seldom that the atmosphere in this climate is positively stagnant. Up aloft, above the chimney tops, there is usually, even on the calmest days, a just perceptible current, which serves to carry away the smoke and vitiated air, and brings fresh air in its place. When, however, during anticyclonic conditions, the atmosphere is positively stagnant, London, in winter, creates an atmosphere which is

positively irrespirable. I need hardly remind you of the week's fog just before Christmas last, nor describe in detail what you all probably experienced.

Nor is this fog to be wondered at when we consider that there are some 800,000 houses in London, each with half a dozen or more chimneys in communication with an open fire-place; that some seven million tons of coal are burnt annually in the metropolis, or some 20,000 tons a day—on a cold winter's day as much as 40,000 tons is said to be consumed—of which daily quantity 200 tons will escape into the air as fine carbon or soot, with probably an equal amount of sulphur as sulphurous acid. There will be also produced about 60,000 tons of carbonic acid to help vitiate the air. The latter, being a gas, would escape easily and diffuse with the fresh air were it not for the suspended sooty particles in the fog; and thus it is easy to understand that the air of a yellow London fog may contain 12 or 14 volumes of this gas in 10,000 parts, as against the normal 4 per 10,000. The evil is bad enough, but it is increasing. Every year some 15,000 or 16,000 new houses are added to London's huge bulk, each burning its due proportion of coal, and the number of foggy days in a year is gradually increasing.

The mortality and illness produced by a dense yellow fog in London is not difficult to demonstrate. For instance, the death-rate of London for the fortnight ending December 19th, 1891, when ordinary atmospheric conditions prevailed, was only 18 per 1,000. The great fog commenced on the 20th, and lasted until night time on the 25th. The death-rate of London for the fortnight ending January 2nd, 1892, was 32 per 1,000, or 14 per thousand in excess of the previous fortnight, and the aggregate mortality from diseases of the respiratory organs in the fortnight exceeded the corrected average by 829. As a matter of fact, the excessive death-rate was very largely due to lung diseases brought on or aggravated by the condition of the atmosphere in Christmas week. Little, if any, part of this heavy mortality can be attributed to influenza, as this disease did not become widely epidemic in London until after the first week in January; but the subsequent high death-rates in London, which then prevailed until the middle of February, are no doubt chiefly due to influenza mortality; although it may well be that the Christmas week fog prepared the way, so to speak, for the influenza, and weakened the defences of the body at the very time when it was most important that they should be at their strongest. At any rate, the epidemic through which London has passed has been far and away more fatal in its effects than either of its predecessors.

Fogs, however, are but exaggerated types of what London air is during all the winter months. They concentrate public attention for a time, but are soon forgotten, like all other experiences which are painful to remember. The smoke, normally present in winter in our atmosphere, cuts off a good deal of light, as witness the "duration of sunshine" records in London and in the country outside of London. Ozone is practically absent from the air of London, and the carbonic acid, even of the most open spaces, is usually about 0·5 per 10,000 parts in excess of that in country air. It is difficult to say what exactly are the effects of the deteriorated atmosphere on the health of Londoners; but I think it may safely be assumed that much of the anœmia, which is so characteristic of London citizens—the pale faces, and disordered digestions—and many of the wasting diseases of children, more especially rickets and scrofula, are to no small extent due to a condition of atmosphere which prevents the perfect action of the lungs, and the complete oxygenation of the blood, and so lowers the tone of the body and the ability to repel the invasion of disease. There is also the irritant effect of the dust and soot particles breathed into the lungs and deposited in the bronchial glands. These foreign particles are not obviously injurious to the majority of people, but they may affect some. In any case they do no good.

We must next consider what remedy, if any, there is for this evil, affecting, as it does, a population of four and a half million people, and increasing, as it does, in magnitude year by year. Many people are inclined to look on London fogs as natural phenomena inherent to London's site and climate, and therefore incapable of remedy. But this is a grand mistake. White mists are, no doubt, inseparable concomitants, under certain atmospheric conditions, of low lying positions on tidal rivers not far away from the sea; but yellow fogs are the products of coal combustion mixed up with nature's white mists, the latter being of a comparatively harmless kind, and limited more or less to night-time, as they are rapidly dispersed by the sun's rays.

It is now generally acknowledged that at least 95 per cent. of the smoke in London issues from the chimneys of dwelling-houses, the other 5 per cent. being "manufacturing" smoke. Consequently any attempt to deal with the smoke nuisance must aim at controlling the methods of combustion adopted by the householder. The manufacturer is already within the law; but the chimneys of private dwelling-houses may pour out as much black smoke as they can, with impunity. I am not an expert in this matter, and I have brought this subject forward more with the view of giving an opportunity to those Fellows,

Members, or Associates of The Sanitary Institute, who are well and practically acquainted with methods of heating and of smoke prevention to express their opinions than to air my own views. After the discussion it may be possible to formulate some resolution which will carry the sense of the meeting, and will show the public the lines upon which The Sanitary Institute is of opinion that the question of smoke abatement in London should be approached.

I will, however, propound the following as being questions to be discussed, and if possible decided one way or another.

(1) Is it reasonable to hope that the voluntary adoption in old houses, or the compulsory enforcement in new houses of smoke preventing stoves designed to burn ordinary domestic house coal, will visibly and satisfactorily abate the smoke nuisance in the metropolis?

(2) Can the use of anthracite or other smokeless coal be made compulsory throughout London, to the exclusion of ordinary house coal, having regard to the fact that such coal is not well suited to burn in ordinary domestic open fire-places, and that the present output is said to be at present only some 4,000 tons a day—London alone requiring on an average at least 20,000 tons a day?

(3) Is it possible to adopt, and render acceptable to the bulk of the ratepayers, a system (municipal or by private enterprise), of heating houses by steam or hot water pipes?

(4) Is the remedy to be looked for in the municipalisation of the London gas undertakings, with the production of a cheap gas at 1s. or 1s. 6d. per 1000 cubic feet? For at this figure gas could be used for heating purposes as cheaply as coal at 20s. per ton, equal heating effects being produced in dwelling-rooms by open gas fires of good design, as by coal fires.

With reference to this latter question, subsidiary questions arise as to whether (*a*) it will be necessary to supply a gas free from illuminants, to be used for heating and cooking purposes only; and (*b*) to manufacture the gas in the colliery districts at the pit's mouth, and supply it to London through enormous mains under graduated pressure; in order that the price may be so low as to allow gas to compete successfully against coal.

I have said nothing as to the adoption of systems of slow combustion close stoves in houses, heated by coke or smokeless coal, as it appears to me that our climate, our habits, and our customs do not admit of, and indeed are strongly opposed to the system, which answers, however, well enough in countries with very cold and prolonged winters, when the chills and draughts produced by open ventilating fire-places would be intolerable. It seems as if no system of heating could be adopted in this

country, which does not preserve, more or less intact, the open hearth, the cheerful blaze or glow of incandescent particles, and the escape of a large quantity of heated air up a flue, constituting the ventilation.

All this is very much against any general adoption of hot water or steam heating in ordinary dwelling-houses; and as far as my own experience goes, smoke preventing stoves are only smoke preventing when properly managed, disobedience to instructions, or carelessness, usually meaning a production of smoke in considerable quantity. The choice seems therefore to lie between the compulsory use of smokeless coal; or the taking of such steps by the citizens, as a whole, as will secure the enormous cheapening of coal gas, and then by placing a tax on all kinds of coal grates, or even upon smoke-producing coal itself, to render it more economical for everybody to burn coal gas as a fuel.

It is true that coal gas produces, for equal heating effect, as much carbonic and sulphurous acids as coal does, but the absence of the suspended carbon soot particles makes all the difference as regards yellow fog. Without the suspended sooty particles in the air to form a nucleus for the moisture, the gaseous products of combustion will be enabled to escape into and diffuse with enormous masses of fresh air, and the dark, black, acrid, suffocating, choking atmosphere, which constitutes the modern London fog, will become a thing of the past. This sounds, perhaps, very optimistic and improbable, but *it is* feasible to restore purity to the London air, if we only set about it the right way. That the results of abolishing smoke would be remunerative, and well worth the vast outlay needed in the first instance, is a statement of the truth of which I am firmly convinced.

As regards the water supply of London, I am afraid we are working within a vicious circle, as we are doing with our air. Year by year London increases in size and population. Year by year the towns and villages, and London suburbs in the Thames and Lee valleys, are increasing as rapidly. The water drawn from the Thames and Lee has consequently to supply an ever increasing population, and the limits will before long be reached, when the resources of these rivers as reservoirs of water, will be stretched to their uttermost.

As the villages and towns on the upper reaches of the rivers and their tributaries increase in size, there is a constantly increased tendency for larger quantities of the waste refuse of these communities to find their way into the streams and rivers which are the natural drainage beds of the localities. This tendency to increase in pollution can only be kept in check

by the watchfulness and devotion to duty of River Conservators, and by increased effort on the part of the water companies in the filtration and purification of the water they supply.

One of the special drawbacks of the Thames and Lee water companies, is the compulsion they are under to take in water from the river, when it is in flood, owing to the insufficient capacity of their storage reservoirs. The turbid and foul water from the river in flood is most difficult to filter effectually, with the result that a coloured, turbid water, containing an undue amount of organic matter, is at such times supplied to the consumers in London. This happened notably last autumn, when, owing to the continuous heavy rains, the Thames was in flood for a very long period, and the water supplied by a great majority of the Thames water companies to London was distinctly much inferior to the average quality. Who can say how much illness and loss of health was attributable to that wholesale depreciation in quality of our water supply?

It will not be amiss to turn to the Reports of the Official Water Examiner to see for ourselves what was the quality of the water supplied to London in 1891.

"At the end of January," writes the Water Examiner, "a practical illustration occurred of the incapacity of the existing works for dealing with the excessively turbid water which the Thames ocasionally affords. The breaking up of the prolonged frost, and the rainfall of the 29th January, produced a flood in the river of exceptionally muddy and polluted water. The filters having already suffered in condition from the great difficulty experienced in cleaning them when covered with ice, were overtaxed by the turbid water which was unavoidably admitted, and the supply delivered into London on the 30th January, and for some succeeding days was much discoloured." Dr. Frankland reported in February that the water abstracted by the Thames companies was, in all cases, of very inferior quality, being polluted by an abnormal amount of vegetable organic matter. That of the Grand Junction Company, supplied to over half a million of people, on the 5th February, surpassed, in respect of organic impurity, any sample of Thames water examined during the past 25 years. It was opalescent from imperfect filtration, and was not in a fit state for dietetic use.

After a time the water appears to have regained its average standard of purity, but in September we find it again reported that the water abstracted from the Thames suffered considerable deterioration in consequence of the flooded state of the river. The supply of the Chelsea Company was least affected, this company having the largest storage capacity for unfiltered

water, viz., 14·1 days supply, or more than double that of most of the other Thames companies.

In October we find that the water abstracted from the Thames by all the companies, except the Chelsea, was very seriously affected by heavy floods. It was brownish in colour, and the organic matter in solution, although chiefly of vegetable origin, had been increased in amount to a very objectionable extent. "It is evident," writes Dr. Frankland, "that these companies, with their present limited storage, are unable to avoid the delivery of polluted flood water."

In November the Thames water supply had generally improved, but it was then the turn of the Chelsea Company to fail; and the water supplied by this company, which was far the best in October, was the worst in November, and contained 73 per cent. more organic matter than that supplied by the Lambeth Company on the same day.

In December the Chelsea supply had improved, but that of the other Thames companies had again fallen back, the excessive floods in the Thames Valley continuing and rendering it "most difficult for the companies, who have but small storage at their command, to send out water fit for dietetic use." The water of the Southwark Company was, indeed, opalescent from finely suspended clay, which was not removed by subsidence or filtration.

From the above quotations it will be seen that during five months of the year 1891, the water supplied to London from the Thames was for the most part of inferior quality, and on several occasions for day's together not fit for dietetic use, that is to say *not safe to drink.* The river Lee is also liable to flooding, and the water abstracted from its lower reaches by the East London Company exhibited fluctuations in quality similar to those affecting the Thames. The only water supplies to the Metropolis that maintain a good standard of purity throughout the year are those of the New River Company from the upper reaches of the Lee, which are comparatively unaffected by floods, and the deep well-waters of the Kent, Colne Valley, and East London Companies, the latter being invariably described as of excellent quality.

Of course it is open to any one to say, that the year 1891 was an exceptionally bad one for the water companies owing to the severity of the frost in the early part of the year, and the tremendous rainfall in the latter part of the year. This may be granted, but still I think we shall all agree that the water supply of London with its 4¼ million of inhabitants ought to be independent of exceptional circumstances of all sorts. As a matter of public health it is not a wise policy, and it is certainly

not a scientific proceeding, to take in grossly polluted waters, such as the Thames or Lee in floods are, and then endeavour to render them potable by storage and filtration through sand and gravel. The endeavour is not always a successful one, as I have shown from official reports, and surely at the end of the 19th century, the citizens of the wealthiest city in the world, have a right to ask that the water supplied to them for domestic purposes shall be, like Cæsar's wife, above suspicion.

Major LAMOROCK FLOWER (London) said he was much interested in Dr. Parkes' remarks on smoke abatement, but he thought it would not be reasonable to make every one alter their stoves nor to institute a house inspection to see that proper stoves were in use. Some difficulty would arise in making the use of anthracite compulsory, and, moreover, if brought into general use, there would not be enough anthracite to supply the demand. Means had been found of reducing the smoke from bituminous coal by treating it chemically, but this did not find favour with the public on account of the trouble it involved. The suggested use of steam and gas for heating purposes would, he thought, never find favour with the English public. With regard to the water question, it was absurd to talk of the Lee being dried-up. A considerable quantity is taken, but it still will find an additional 10,000,000 gallons daily. The pollution of rivers could be almost entirely prevented by proper inspection. In the Lee, for instance, the water at the intake of the water-companies is equal to the purity of the river at its source; but in the Thames the present procedure against offenders is too cumbersome. He believed that it would be proved that there is plenty of water in the Thames and Lee water-sheds for the supply of London; and he thought the London County Council had gone mad on the idea that another source of supply must be found. It would be fifteen years before Welsh water could be brought into London, and in the meantime nothing or little would be done to improve the present source of supply.

Mr. ROGERS FIELD, M.Inst.C.E. (London), said he suggested some years ago that the use of smokeless fuel might have been encouraged by only remitting the "coal dues" on this kind of fuel, and leaving them on ordinary smoke-producing coal. The great difficulty in the question of smoke and fog is to convince people that it is necessary to deal with it. Ordinary Londoners think that they cannot help the fogs, and that after all fogs do not do much harm. That this view is a mistaken one is shewn by the fact that directly after serious fogs there is a great increase in the deaths from diseases of the respiratory organs. It is no use saying you *cannot* deal with the fog; you *must*, if fogs make it impossible to live in London, and things certainly seemed to be tending that way. On the question of the water supply, he

thought the comparative purity of the Lee was due to the fact that the whole valley, including the tributary streams, was under inspection. In the Thames only the main stream and ten miles up the tributaries were under inspection, and this was not sufficient, as a great deal of pollution was brought down by the higher portions of the tributaries. It would be a long while before London could obtain its water supply from other sources, though it may be necessary eventually; in the meantime the present sources of supply ought to be thoroughly inspected, and the supply made as good as possible. He could not agree that London could rely altogether on the Thames and the Lee for its water supply. The large amount of manured land in the water-shed of these rivers would always considerably add to the pollution. He thought that the whole question of the sources of supply should be dealt with in reference to the needs of the country at large. Dartmoor, Wales, the Lakes, and some areas in Derby, were practically free from pollution, and he thought that all available sources of supply ought to be mapped out and allotted to different districts. He moved that, "In the opinion of this meeting of Fellows, Members, and Associates, of The Sanitary Institute, Parliamentary permission should be withheld from all large appropriations of water-bearing areas in Wales or elsewhere, until the Royal Commission on Sources of Water Supply about to be appointed has reported."

Mr. F. T. Poulson (Chelsea) seconded the resolution. He was glad that the Birmingham Water-bill should be the means of making London look to its water supply. There was no doubt that fogs caused a good deal of injury to child-life, and destroyed comfort. Gardening in London is a good indicator of the purity of the air.

Dr. H. R. Kenwood (London) said that with regard to the prevention of fog he thought that the adoption of coal-gas in place of coal was the most likely to be adopted, but the question arose as to what the injurious effect of fog is due to, and whether the burning of so much gas would prove an advantage to the public health. By the universal adoption of coal-gas for heating purposes we should certainly be spared the dark and dirt of our London fogs, but it is a question whether the very large amount of injurious gases which would escape into the atmosphere as products of coal-gas combustion, and which—under those atmospheric conditions which give rise to fog—would be held down over the city to be respired, would not suffice to render the air just as injurious as it is under the present circumstances. He thought it might be possible to find some source of heat other than that of coal or coal-gas combustion.

Mr. S. C. G. Fairchild (London) thought that a good deal of the pollution of the Thames in dry seasons was due to the house-boats on the river. He asked whether it was a fact that water passed through crushed flints, absorbed silica, and prevented the water acting on lead-pipes.

The CHAIRMAN (Sir Thomas Crawford) said he quite agreed with the resolution proposed by Mr. Field with regard to the water-supply of London. He thought that the attention of the public had been principally directed to the surface water, but that we should also consider the water-bearing strata underlying the Thames and the Lee, where possibly we might find a great augmentation of our present supply. In most cases the sub-soil is a great store-house of water. If surface water is used, it is of great importance to secure gathering grounds free from impurities. With regard to fogs, he was particularly struck with the health aspect of the question, and he thought it would be very useful if every health officer would estimate the consequence of exposure to fogs, and suggested that the degeneration of Londoners might be due to fogs.

The resolution proposed by Mr. ROGERS FIELD was carried unanimously.

Moved by Dr. H. R. KENWOOD and seconded by Mr. COATES, and carried unanimously, "That it is important in the interests of the public health that London fogs should be enquired into by a Royal Commission."

Dr. LOUIS PARKES (London) in reply said, no doubt the physique of Londoners was degenerating. With regard to the uselessness of inspecting only ten miles up tributary streams he instanced an outbreak of typhoid by which pollution was carried into the Wey and so to the Thames.

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HELD AT PORTSMOUTH, 1892.

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ON

THE VICTORIAN ERA, THE AGE OF SANITATION.

BY SIR CHARLES A. CAMERON, M.D.,

PRESIDENT OF THE CONGRESS.

MY first duty, as President of this Congress, is to tender on behalf of the Sanitary Institute most cordial and hearty thanks to the Mayor, Municipality and people of this ancient town for the kind reception they have accorded to their visitors. This town has no reason to dread the scrutiny to which it will be subjected by the swarm of hygienic critics attracted by this Congress, for it would be indeed a happy day for these countries if all their towns were as healthy as Portsmouth, which in this respect is only exceeded amongst the great towns by three, namely, Norwich, Derby and Brighton. In the period 1881-90 the average death-rate in the 28 largest towns of England was 23; in Manchester it was 29·6; in Portsmouth it was 19·6; in Brighton 19·0; in Derby 19·3; in Norwich 19·1. These are the death-rates, corrected by age and sex distribution, and by the results of the census of 1891.

My next duty is to express my thanks to the Council of the Sanitary Institute for the honour which they have done me in selecting me to preside at this important Congress, in which are assembled so many of the most distinguished Sanitarians of these countries, and to whom I am sure my arguments will seem trite and my facts threadbare. I believe that I am the first Irishman who has been invited to preside at any of the great annual gatherings held under the auspices of the Sanitary Institute. Perhaps I may be permitted to accept the fact as a compliment paid, not so much to so humble an individual as myself, as to the country from which I come, and which, indeed, has of late years no reason to complain of being unnoticed by the people on this side of the Channel.

The reigns of many of the Sovereigns of these countries have

been rendered famous by successful wars, by great acquisition or loss of territory, by religious and political revolutions, by the works of intellectual giants, such as Shakespeare, Bacon, and Newton. The prosperous and prolonged reign of our beloved Queen has been as pregnant of great events as any of her royal predecessors, but the happiest and most characteristic feature of her glorious reign of five-and-fifty years is the remarkable improvement which, during that period, has taken place in the health and comfort of her people. The Victorian era is the age of sanitary and social reforms—of diminished sickness, of increased longevity. Never has the British people been so free, so happy, so rich, so powerful, so educated, so moral, so philanthropic, so healthy as during the Victorian era.

From the earliest ages, since the people of these Islands emerged from barbarism, some attention was given to the subject of public health, and a few enactments, more or less relating to the health of the people, may be found on the Parliamentary Statute Books and amongst the edicts of the Sovereigns previous to the nineteenth century. Their provisions were, however, rarely enforced, and if all the Sanitary Acts passed before Her Majesty's reign were collected, they would form a volume of no great size. Let us see what the Victorian age of Sanitary legislation and literature has produced.

The first important official report in reference to the health of the people was issued in 1842, under the title of "Report of the Sanitary Condition of the Labouring Population of Great Britain;" it was soon followed by legislative action. A Factory Act was passed in 1844, and this was the first of the many general statutes more or less relating to the public health enacted during Her Majesty's reign. In 1845 a Nuisances Removal Act was passed, and in 1848 the well-known Nuisances Removal and Diseases Prevention Act was put on the Statute Book. In 1866 a useful "Sanitary Act" came into operation, and in 1872 was followed by a Public Health Act. The Common Lodging Houses Act of 1851 was the first that dealt specifically with the dwellings of the poorer classes of the community. These six Acts of Parliament have all been amended and extended—some of them a great many times—and they and the amending Acts constitute perhaps the most comprehensive code of sanitary laws ever enacted in either ancient or modern times. In addition to those Sanitary Acts, other important ones have been passed in relation to burial grounds, mines, town parks and open spaces, the adulteration of food and drugs, the diseases of animals used as food, the sale of milk, margarine, and poisons, the pollution of water, trade nuisances, the construction and management of bake-houses, the storage of explosives and petroleum. Numerous private Acts of Parliament, obtained by

local authorities, are either altogether sanitary or contain clauses relating to sanitation.

Numerous as are the volumes of Sanitary Laws, they are exceeded by those containing the evidence in relation to sanitary matters given before Parliamentary Committees, Royal Commissions, and "Departmental" Committees, together with the reports thereon. These "Blue Books" constitute an immense library, in which voluminous details are given in relation to the dwellings, occupations, food, water supplies, diseases, and medical relief of man; and to the hygiene and municipal administration of towns. The Blue Books issued from the Medical Department of the Local Government Board and the Army and Navy Medical Departments are numerous and valuable.

A third department of sanitary literature consists of the annual and special reports of the Medical Officers of Health, which may be numbered by thousands. They are the annals of sanitary progress. Until very recently they dealt only with the health of towns; but in the future we may expect valuable reports on purely rural districts from the County Medical Officers of Health. Until now nothing worth boasting of has been done to improve the status of health in the open country; but the last Local Government Act has created for the rural districts Sanitary organizations similar to those which have long existed in towns. We might venture to hope that under the new regime of County Councils, the well-known rural death-rate of 17 per 1,000 may be reduced to 16 or less.

Not so numerous as the reports of Medical Officers of Health, but not less interesting, are the Transactions and Journals of The Sanitary Institute and similar organizations. The journal of the Statistical Society is rich in Sanitary literature. The Transactions and Journals of Medical Sanitary Societies and of the Public Health Sections of Medical Associations contain numerous contributions to hygienic literature.

Public health has its representatives amongst the periodicals of the day; for example, the "Sanitary Record," "Hygiene," the "Health Record," &c. It has also special departments assigned to it in most of the purely medical journals. In May of the present year a welcome addition to our periodical literature appeared in the shape of the "Journal of Pathology and Bacteriology," in which, judging by the names of intending contributors on its title-page, we may expect some brilliant writing on the causation and prophylaxis of microbial diseases.

Prior to the Victorian age there was only one really comprehensive and philosophical book on Hygiene published in Great Britain; this was the "Philosophy of Health," by Dr. Southwood Smith, which appeared in 1838, and which still may be read with advantage. For some years past dozens of books, more or

less relating to public or private hygiene, issue annually from the Press; many of them of large size, as for example, the ponderous book by Stevenson and Murphy, issued in the present year, and which, though only the first volume of a treatise, numbers 1018 large pages.

There is no more convincing evidence that this is the age of sanitation than the fact that the books on the subject published within the Victorian era would furnish a large library, whilst those of an older date would hardly garnish a single book-shelf.

The higher estimation of preventive medicine, which lately prevails amongst the professors of the healing art, is shown by the recent institution of degrees, diplomas and certificates in Public Health, State Medicine, and Sanitary Science by the universities and medical and surgical corporations. I am proud, as a citizen of Dublin, to be able to state that the university of that city was the first to create a diploma in state medicine. That was in the year 1865. Its example has been followed by all the other medical licensing bodies, and there are now some hundreds of holders of sanitary qualifications. I may also be permitted to say in this connection that the Professorship of Hygiene, which I hold in the Royal College of Surgeons, Ireland, was the first instituted in Europe, with, I believe, one exception, namely, that in the Medical School of Montpelier. The Chair of "Hygiene or Political Medicine" of the Irish College of Surgeons was established in 1844.

Quite recently some of the medical licensing bodies have decided to require of candidates for their ordinary diplomas, evidence of study in Sanitary Science; and for the Public Health Diplomas it must be shewn that the candidates have worked in a chemical sanitary laboratory, and have studied the duties of a health officer under a Medical Officer of Health. It is a good sign of the times to find that the Medical Act of 1887, made Public Health Diplomas registrable qualifications.

In the future no one will be eligible to act as Medical Officer of Health for a town of 50,000 inhabitants and upwards unless he holds a registrable qualification in public health.

Before the Victorian era there were few Sanitary laws worth administering, and consequently no *raison d'être* for local boards or officers of health. Some drainage works were carried out by the town and country authorities, and a few attempts were made to improve the water supplies of urban districts. The filth produced in towns had to be got rid of in some way; on the other hand people were taught to be too economical in the combustion of fuel by the imposition of a rate on hearths, and they were encouraged to exclude daylight by having to pay a window tax.

The insanitary state of British towns was made painfully

evident by the invasion of cholera in 1831. According to official statistics there died from cholera in 1831–2, 31,376 persons in England and Wales, and 21,171 in Ireland. In 1848 cholera re-appeared in England and Wales, and destroyed 53,273 lives. In 1853, 20,097 deaths were ascribed to cholera, of which about one-half occurred in London. In 1866 it re-appeared, but with less fatal results. The deaths in England attributed to it were 14,378, in Ireland 2,501, and in Scotland 1,470; total 18,349. This lessened mortality was not due to the milder character of the disease, but rather to the towns being less filthy than they were during previous visitations. On the Continent so virulent and widespread was cholera at this time that it is computed it caused more than one million of deaths. In Italy alone it carried off 120,000 victims; and in the small countries of Holland and Belgium it caused 50,000 deaths.

When cholera first appeared in Dublin in 1831, the sanitary state of the city was deplorable, and consequently 5,632 out of a population of a quarter of a million perished. When it came again to Dublin in 1849, the condition of the city was not so bad, and the victims to cholera were only 1,664. In 1866 Dublin was for the third time visited by cholera, and on this occasion 923 deaths were caused by it. Sanitary matters were in 1866 better than in 1849; and were the disease again to invade Dublin, I venture to hope that it would be much less fatal than in 1866. I think that in British towns generally Asiatic cholera will not again cause such ravages as it did in 1831, 1848, 1854, and 1866. I am not very apprehensive that the epidemic which now rages on the Continent of Europe—in which it has appeared seventeen times since 1829—will extend to our islands.

It was probably the ravages caused by cholera in 1831–2, and more especially in 1849, that first awakened the public to the necessity of improving the hygienic conditions of towns. A committee appointed to enquire into the sanitary condition of the Metropolis reported in 1848 that no substantial improvement had taken place in the state of the back streets, lanes, alleys, and courts since the cholera epidemic of 1831–2. The committee expressed an opinion that if the disease were again to visit London, it would spread as extensively and prove as fatal as it did in the former visitation. This prediction was unfortunately but too soon verified; but in the meantime the era of sanitary activity was initiated by the passing of the Public Health Act of 1848. This Act, though it permitted and did not compel sanitary reforms, was a useful one, and was availed of to some extent, as was also the case with the Local Government Act of 1858.

An important agency in promoting sanitary legislation were

the valuable reports—issued in 1842 and 1845— of the Commission on the Health of Towns.

The powers conferred upon health authorities, at first almost invariably permissive, gradually became more of a mandatory character. What a difference, is there not, in the significance of these two words "shall" or "may" in a sanitary statute! The exercise of the powers vested in local authorities has resulted in the expenditure of an enormous sum of money. It has mainly been employed to secure pure water supplies, to construct drains, to pave streets, to thin out densely-inhabited places, to clear unhealthy areas, to erect dwellings of a healthful kind for the working classes, to provide public abattoirs, baths and wash houses, town parks and open spaces, to build and maintain fever hospitals, to adopt improved methods of filth disposal. The maintenance of staffs of sanitary officers has caused a large addition to the taxation of towns. Formerly very few towns were provided with even a single Inspector of Nuisances. In 1864 Dublin had but one sanitary officer, now it has nearly fifty. It must be admitted that the administration of the sanitary laws involves a substantial outlay of money. It is, however, money well expended. It gives a good return in the form of a lessened sickness rate and reduced mortality. It diminishes pauperism, by preserving the health of the working man. The death of the labourer by a preventable disease may have the effect of sending his children into the workhouse. Sanitation has greatly reduced the mortality caused by preventable diseases. We pay enormous sums for an Army and Navy to preserve us from foreign foes, to protect our liberty, property and lives. But there are foes our brave sailors and soldiers cannot defend us from—enemies that kill annually far more than ever fell upon the battlefields during our greatest wars. These enemies are the infective diseases, which are not necessarily concomitants of human nature, and the attacks of which may be, and some day shall be, warded off. We require an army of sanitarians to guard us against those deadly foes. They who vanquish them achieve victories far more glorious than ever warrior won. They are triumphs which are not followed by the groans of the wounded, the wail of the widow, or the cry of the orphan. The trophies of the conquest are increased health, life, and wealth to man.

As the soldier to be effective must be skilfully trained to the use of arms, and grounded in the knowledge of tactics and strategy, so should the sanitarian be thoroughly instructed in the principles of hygienic science, and capable of using the necessary instruments of research. It is not long since every medical man was considered perfectly competent to act as an officer of health, but now the model medical officer of health is expected

to know more than the ordinary practitioner. He is required to be familiar with the use of meteorological instruments, to have some knowledge of geology, to understand sufficient engineering, to know how sewers and drains should be constructed, trapped and ventilated. He may be called upon to suggest how the noxious effluvia from certain factories may be rendered innocuous. He is often requested to pronounce as to the fitness or unfitness of the flesh of animals as food for man, and he cannot do that properly if unacquainted with the diseases of those animals. Not unfrequently he acts as an analyst and examines potable water, determines the amount of carbonic acid in the air of places suspected of being unhealthy, and does other sanitary-chemical work. As yet he has not been called upon to do much as a bacteriologist, but in the immediate future the candidate medical officer of health will be expected to have a thorough knowledge of the pathogenic microbes; to be able to determine the number of micro-organisms per cubic centimetre of water, and to be an adept in the "cultivation" of bacteria, bacilli, spirilla, *et hoc genus omne.*

The medical officer of health will be something more than a physician and surgeon—he will, in a sufficient degree, be a bacteriologist, chemist, a veterinarian, a geologist, an engineer, a statistician, and, so far as the Sanitary statutes are concerned, a lawyer. Already several medical officers of health have taken the Barrister's degree.

Until quite recently there were no special arrangements made in the medical schools for teaching Sanitary Science; but this defect is being remedied, especially as regards the sanitary analysis of air and water, and the chemical and microscopical examination of food and drugs. Courses of lectures on hygiene and State medicine are also delivered, but at present not in all the medical schools. On the Continent bacteriological laboratories have been established in nearly all the Universities and seats of medical education, and in the great Pasteur Institute at Paris the methods of identifying and "cultivating" microbes may be studied. In these countries there is no great institution altogether devoted to researches into the intimate nature of those organisms, invisible to the unassisted eye, apparently almost without structure, yet endowed with a virulent potentiality rivalling that of strychnine or prussic acid. How marvellous, is it not, that we discover upon the confines of the visible world the causes of some of the most fatal diseases of man and of his subjects in creation!

There are few natural phenomena more wonderful than the enormous dynamic effect produced upon organized matter by these microscopic objects. A few, perhaps even one, of them introduced into the body of the largest animal may quickly raise

its temperature and deprave its vital functions, disorganising the whole living mass, which exceeds in dimension its enemy by countless billions. Shakespeare, whose genius was prophetic as well as sublime, anticipated the modern description of infective matter when he spoke of it as that "whose effect holds such an enmity with blood of man that, swift as quicksilver, it courses through the natural gates and alleys of the body, and with a sudden vigour it doth posset and curd, like eager droppings into milk, the thin and wholesome blood."

Some provision for the study and teaching of bacteriology has been made by Cambridge University, the Colleges of Physicians and Surgeons, London and Edinburgh, the College of State Medicine, the Brown Institute, and, but to no great extent, in a few other places. We have no place which can be compared to the Pasteur Institute in Paris; it is the largest and best equipped bacteriological laboratory in the world. The British Institute of Preventive Medicine, established in 1890, proposes to found a bacteriological laboratory and accessories, on a scale equivalent to that of the Pasteur Institute. For this purpose it asks the rich and generous British public to subscribe £100,000. Some handsome donations, including one of £2,000 from Mr. Mond, have resulted from this appeal; and let us hope that British philanthropy, to which we are indebted for many noble gifts to the Nation, will endow an institution, the objects of which are eminently for the benefit of man.

Hardly less important than the Medical Officers of Health, and the Medical Inspectors of the Local Government Board, are the rank and file of our sanitary army—the Inspectors, or rather *discoverers*, of Nuisances. Formerly anyone was considered competent to do the work of the Sanitary Inspector, and persons who had been failures in other walks of life were often provided for by appointing them to be Nuisance Inspectors. This happily is now as a rule an exploded practice. It is realized that the person who has to discover sanitary defects in dwellings, public institutions, factories, schools, and other places, should have some acquaintance with the laws of health. The Sanitary Institute never did a better thing than the institution of their certificates for Inspectors of Nuisances, and also for Local Surveyors. Since 1877 no fewer than 1,312 candidates for the sanitary certificate have been examined, of whom 825, or 63 per cent., were successful. During the same period 78 local surveyors received certificates, and 113 were unsuccessful.

During the Victorian age many millions of money have been spent in the execution of sanitary works, and in the maintenance of a legion of sanitary officers. Have the results of this vast expenditure of money and human labour been such as to satisfy

us that it has not been a waste of our pecuniary resources and our time? Do they encourage us to further outlay and increased exertions? I think both queries may be answered affirmatively. That money spent to improve the sanitary condition of places has not always been judiciously laid out is quite true, but the same may be said of expenditure for most other public purposes. It must, moreover, be admitted that the provisions of many of the Acts relating to health have not been fully carried out, and that many local sanitary authorities, especially in rural districts, have lamentably failed to perform the duties, whether permissive or mandatory, entrusted to them by Parliament. It would not be difficult to discover places where the sanitary statutes are almost or wholly dead-letters. They would indeed be dead letters in more places than they are were it not for the powerful influence exercised upon public opinion and on the conduct of the authorities by the Medical Department of the Local Government Board by such organizations as the Sanitary Institute, and by the pen and voice of earnest sanitarians. There are hundreds of towns and villages in these islands which are still unprovided with proper arrangements for drainage and filth disposal, and which are dependant upon scanty supplies of water, often of bad or inferior quality. On the whole, however, it must be admitted that the sanitary powers confided to the local authorities have been largely put in force. Let us see what good has resulted therefrom.

I do not propose to institute, except in the briefest manner, comparisons between the England of to-day and the England of a century or two ago. From 1700 to 1750 the death-rate in London was so high that population stagnated. In the former year the inhabitants numbered 665,200, and in the latter year 653,900. During this period the deaths were in the ratio of about 1 per 30 persons living. By 1801, the population had crept up to 777,000 and the deaths had fallen to 1 in 41 persons living. This great improvement in the state of public health in London was not, except in a trifling extent, the result of Sanitary legislation. People were becoming more enlightened on many matters affecting their health, partly owing to a more general knowledge of chemistry, physiology, and other sciences relating to man and his surroundings. When those entrusted with the conduct of public affairs became aware how much the health of people was affected by bad water, by foul emanations from cesspools, and by too great a density of population, they began to secure supplies of pure water, to construct proper house drains and street sewers, to remove systematically filth from houses and roadways and to widen streets. The promulgation of the natural laws of health preceded the enactment of laws of health by the State. Jenner's discovery of

prophylaxis in small-pox had for its corollary the vaccination laws. The chemical analysis of water was the basis of Acts of Parliament relating to water and rivers.

Until about 40 years ago common-sense was the only motive power which impelled sanitary reforms in London and elsewhere. It was not inoperative, for early in this century the grosser defects in public and private hygiene had been recognised, and, to a great extent, remedied.

In Rickman's Report to Parliament on the Census of 1811, he gives the following estimates of the death-rates in England:—

In 1780	... ...	1 death	per	40	persons	living.
„ 1790	... ...	1 „	„	45	„	„
„ 1800	... ...	1 „	„	47	„	„
„ 1810	... ...	1 „	„	49 or 50		„

If these estimates are reliable, it would seem that after the great improvement in the public health in the latter part of the eighteenth and early portion of the nineteenth century no sensible change for better or worse took place for about half-a-century. According to Rickman, the death-rate in 1810 would be about 20 or 21 per 1,000 persons living.

In Dr. Newsholme's excellent work on "Vital Statistics" he gives the death-rate for males in the period 1838-1854 as 23·28 per 1,000 males living, and the rate for females at 21·65. It would therefore appear that the mortality of the population had increased as the century grew older. Probably the earlier statistics, collected before the Act for the registration of births, deaths and marriages, were not quite accurate; no doubt some deaths escaped record. It would, however, seem that from 1810 to 1854—making some allowance for defective registration—there was no reduction in the death-rate. Even if we take the period 1851-60 we find no improvement: the deaths were in the ratio of 22·25. In 1861-70 the rate was 22·5, or 0·25 more than in the previous decade. It must, however, be borne in mind that from the beginning of the century population was increasing rapidly in the towns—which must always, at their best, be less healthy than the country—whilst in the rural districts population remained stationary or declined. It was therefore something to boast of, that although the towns of England were increasing in population at the rate of from 200,000 to 300,000 annually, the death-rate of the whole country had not sensibly increased.

In 1872 a Public Health Act was passed, which was amended and improved in 1875. This Act has been one of the most valuable ever passed, and to its operation must be reasonably attributed the improvement of the public health during the last two decades.

During the ten years ended in 1850 the mean annual death-rate in the metropolis was 24·8 per 1,000 persons living; in 1851-60 the rate was 23·4, and in 1861-70 it was 24·1. During these thirty years there was no marked improvement in the sanitary state of London. Now comes the epoch of sanitary activity: in the period of 1871-80 the death-rate fell to 22·5, and in the decade ended in 1890 it further declined to 20·5, or 4·3 below the rate for the period 1841-50. If the death-rate in Greater London was as high during the years 1881-90 as in the period 1841-50 nearly 50,000 more deaths would have taken place.

Early in the century the provincial towns were with few exceptions more insanitary than London. In reading the local literature of these places one often comes across descriptions of the abodes of human beings which are almost incredible, and which happily would now apply to very few English towns. In a pamphlet, entitled "Religion and Crime," by Mr. John M. Morgan, and published by Longmans, London, in 1832, a dreadful description of Bristol is given. The author states that 566 families occupied each only *part of a room*, and that 2,224 families lived each in a single apartment. In a report upon the sanitary state of Nottingham, in 1839, by Mr. Falkiner, it is stated that there were between seven and eight thousand houses in that town placed back to back, without any through ventilation and unprovided with the proper appliances of civilized life. It is not surprising that in Nottingham 99,017 cases of fever occurred in the years 1835-6 and 7; but it is surprising to find that notwithstanding the acknowledged unhealthiness of back-to-back houses nearly 10,000 of them still exist in Manchester; need we then wonder that the mortality of the inhabitants of that great city exceeds that of every other of the great towns of England!

Mean annual death-rate in England and Wales:—

Period.	Males.	Females.	Total.
1841-70	23·3	21·5	22·4
1871-75	23·3	20·7	22·0
1876-80	22·1	19·5	20·8
1881-85	20·5	18·3	19·4
1886-90	20·0	17·8	18·9
1891	21·5	19·0	20·2

In 1851-60 the death-rate in large towns was 24·7, and in the country 19·9. In 1888-91 the rate in the towns was 20·4, and in the country 17·5.

The year 1891 was an unhealthy year, as will now and then be the case; but even in that year the mortality was much below that of the period 1841-70. If it were equal to the mean rate for that period there would have been 63,749 more deaths during the year.

The low death-rate in England is all the more remarkable

when we consider the very large proportion of the population located in towns. In 1892, 18,931,070 persons lived in towns and 10,472,276 in the country; total, 29,403,346.

Whilst the death-rate of London has been declining the population of the great city has been increasing and concentrating. In 1841 the density of its population was moderate, *i.e.*, 25 persons per acre; but in 1891 there were 56·5 persons per acre. Large and dense populations are as a rule more unhealthy than small and widely scattered ones. In London the unfavourable influence of the closer approximation of its inhabitants, is much more than compensated for by the great improvements effected in the general hygienic conditions of the City.

In every other large country in the world the rural population greatly exceed the urban; in England it is the reverse, 19 out of its 29 millions live in the big towns. It is surprising that under such conditions, the whole population of England have a greater longevity than the French, Germans, Russians, Italians, and Spaniards. It is observed that whilst the mortality of males under 35 years of age, and females under 45 years has been largely reduced, the mortality of males over 35 years, and of females over 45 years has increased. I can hardly believe that this is due to the elder persons being now more than formerly injuriously affected by insanitary conditions. Much more likely is it the result of the preservation of the lives of delicate or weakly children, who developing into adults of poor physique, and low longevity, lower the average death-rate of the adult classes; for as Dr. Newsholme has truly said, the same causes which have lowered the mortality of children and young people, have also improved the average health of those who survive. It is at least certain that the mere expectation of life as it is termed—that is the probable duration of a life, at birth—has been largely increased within the last 25 years. As women and children are most exposed to the bad effects of insanitary dwellings, it seems probable that their improved health is due to improved domestic hygiene. Men are exposed to greater risks of loss of health and life than women or children. Accidental deaths are more frequent with them; and their occupations are often of an unhealthy kind. For one woman in the accident ward of a hospital there are half a score of men.

With respect to Scotland, we gather from the Annual Reports of the Registrar-General of that country, the latest of which refers to 1889, the following facts:—

The mean death-rate in Scotland during the period 1855-64 was 21·3 per 1,000. The rate remained much the same until the period 1880-89, when it fell to 19·3. In 1855-64 the rate

in the large towns was 27·74; in the ten years ended 1889 the rate was only 22·78.

With respect to Ireland the great Public Health Act, under which the Sanitary authorities now work, came into force in 1878. In the years 1871-80, the average annual death-rate per 1000 of mean population was 18·3, and in the ten years ended in 1890, 17·9. During these periods the rates in the Poor Law Unions, or Superintendent Registrars' Districts, containing towns which had in 1871 or 1881, a population of 10,000 or upwards, were 22·5 and 22·6 respectively. These figures would seem to indicate some progress in the rural districts, and a slight retrogression in the urban districts. There are, however, strong reasons to believe that until 1879 registration of deaths was very defective in Ireland. The 191st Section of the Public Health (Ireland) Act, 1878, "provided that the clerk, or secretary or registrar of every burial board and cemetery company or authority, having charge of any burial ground, shall make, or cause to be made, at such times and in such manner as the Local Government Board may direct, a return of the names, addresses, dates of death, and causes of death, so far as ascertained by him, of the persons whose bodies have been interred in such burial ground, to the registrar of the district in which such persons resided at the dates of their deaths respectively." As the clerks to the burial boards are paid for these reports, it is highly probable that they never fail to make them. It was found in Dublin that the returns of burials exceeded by 10 per cent. the registered deaths, from which it follows that previous to 1879 a large number of deaths was not registered, and the published death-rate was 10 per cent. or so below the true rate. It is probable that in many foreign and British Colonial cities, the published death-rates are not the true rates—some of them are suspiciously low.

In the case of the Irish urban districts it is highly probable that the registration of deaths was much more accurate in 1881-90 than previously; hence it follows from the figures which I have given that the true death-rate was less in 1881-90 than in 1871-80.

The general death-rate in Dublin declined in the period 1881-90, 15·59 per cent. as compared with the previous ten years, and the decline in the zymotic death-rate was 44·05 per cent.

There is no department of State medicine of greater utility than vital and mortal statistics. But for their use public attention could not be directed to abnormal mortalities, with the view of reducing them to reasonable proportions. What an important lesson, is it not, to us to know that in the country only 17 persons die yearly out of every 1,000 persons living,

whilst in towns from 19 to more than 30 perish annually! A knowledge of such facts as these—which we learn from the statistician—has been the principal and most successful argument used in pleading the cause of sanitary reform. We shall not be satisfied, says the sanitary enthusiast, until there shall be a uniform death-rate in town and country. Much has been done in rendering the conditions of town life more healthy than they were, but vast is the task still to be accomplished. We see that four more persons per 1,000 die in the town than in the country; but the difference between urban and rural mortality is even greater than this. The population of the whole country is distributed into groups according to age. The death-rate in the different groups is ascertained; in some it is very high, in others very low. For example, from 10 to 15 years the mortality per 1,000 is less than one-half as compared with the ages 25 to 35. In the towns the population have a larger proportion of persons whose expectation of life is longest. Brighton and Plymouth are the only exceptions to this rule. Females live longer than males, therefore a larger preponderance of females in a town than in the country at large lowers the apparent death-rate of the former. The "recorded" or crude death-rate in towns is corrected for what in statistical terminology is termed "age and sex distribution." In 1890 the recorded death-rate of Portsmouth was 19·59, and its corrected death-rate 20·18. In Manchester the crude rate was 30·57, and the corrected one 34·06.

The vital and mortal statistics of towns being the principal means by which their actual and relative sanitary states can be ascertained and compared, it is desirable to collect them accurately. Mortal statistics are useless unless we know the number, ages, and relative proportion of males and females of the population to which they refer. This information is obtained only once in ten years. The increase of population (if any) between the year in which a census had been taken and that which next followed having been ascertained, it is assumed that a similar increase goes on subsequently to the second census. The census of 1891 proved that the estimates of population for the previous ten years were very inaccurate in the case of several towns. For example, the annual increase of population in Belfast was estimated to be 1·3 per cent. per annum, but it proved by the census of 1891 to be 2·5 per cent. On the other hand, Liverpool was found to have had its population in 1891 over-estimated by nearly 100,000. A comparison in 1890 of the death-rates of Belfast and Liverpool would have been unjustly to the disadvantage of the former. In the last Annual Summary of the Registrar-General of England of births and deaths in towns, the usual

correction for the death-rates is not given, owing to the numbers of the population according to the census of 1891 not having been revised. I have, using the census returns of 1891, recalculated and corrected for age and sex the death-rates in the English (28) towns for the period 1881-90, and find it to be as follows:—From all causes, 23; from the principal zymotic diseases, 3·1. These rates are higher than the corrected rates published during the decade. I give a table shewing the correct death-rates in English and Irish towns for this period, and some previous ones.

	England & Wales.	Dublin.	Belfast.
All ages	1,000·00	1,000·00	1,000·00
Under 5	135·55	108·61	123·05
5 to 20	327·05	289·43	326·03
20 to 40	295·02	345·78	332·28
40 to 60	158·60	183·63	156·43
60 and upwards	73·78	72·55	52·21

Recorded and Corrected Death-rates per 1,000 *in Twenty-eight Great Towns in* 1890.

Towns in the order of their Corrected Death-rates.	Recorded Death-rate.	Corrected Death-rate.	Comparative Mortality Figure.
England and Wales	19·19	19·19	1000
England and Wales less the twenty-eight Towns	18·19	17·79	927
Twenty-eight Towns	21·35	22·75	1186
Nottingham	16·47	17·46	910
Brighton	17·76	18·29	953
Leicester	17·92	18·77	978
Derby	18·51	19·25	1003
Hull	19·25	19·86	1035
Bristol	19·21	19·88	1036
Norwich	21·06	20·14	1050
Portsmouth	19·59	20·18	1052
Huddersfield	18·98	20·84	1086
Birkenhead	19·69	21·06	1097
London	20·30	21·55	1123
Birmingham	20·74	22·12	1153
Plymouth	22·42	22·20	1157
Wolverhampton	21·82	22·50	1172
Bradford	20·39	22·52	1174
Cardiff	20·76	22·53	1174
Oldham	21·23	23·56	1228
Sunderland	22·72	23·66	1233
Leeds	22·63	24·19	1261
Salford	22·36	24·34	1268
Halifax	22·46	24·40	1271
Blackburn	23·47	25·58	1333
Liverpool	23·55	25·84	1347
Sheffield	24·93	26·81	1397
Newcastle-upon-Tyne	25·87	27·38	1427
Bolton	25·78	28·25	1472
Preston	27·43	29·79	1552
Manchester	30·57	34·06	1775

Twenty-eight Large English Towns, 1881-1890.

Towns.	Recorded Death-rate.	Corrected Death-rate.	Zymotic Death-rate.
28 Towns	21·6	23·0	3·1
London	20·5	21·8	3·0
Brighton	18·5	19·0	2·2
Portsmouth	19·0	19·6	2·7
Norwich	20·0	19·1	2·4
Plymouth	21·4	21·2	2·5
Bristol	19·3	20·0	2·1
Wolverhampton	21·7	22·4	2·6
Birmingham	20·8	22·2	3·0
Leicester	20·6	21·6	3·1
Nottingham	21·5	22·8	3·0
Derby	18·6	19·3	2·1
Birkenhead	19·9	21·3	2·5
Liverpool	26·3	28·9	4·1
Bolton	22·4	24·5	3·4
Manchester	26·6	29·6	3·5
Salford	24·5	26·7	4·3
Oldham	23·9	26·5	2·7
Blackburn	24·8	27·0	3·8
Preston	26·5	28·8	4·9
Huddersfield	20·8	22·8	2·0
Halifax	21·2	23·0	1·6
Bradford	20·4	22·5	2·4
Leeds	22·1	23·6	3·2
Sheffield	22·0	23·7	3·5
Hull	21·0	21·7	3·1
Sunderland	22·7	23·6	3·4
Newcastle-upon-Tyne...	22·5	23·8	2·9
Cardiff	20·7	22·5	3·1

Re-calculation of Death-rates in English Towns.

Years.	Large English Towns.		
	Recorded Death-rate.	Corrected Death-rate.	Zymotic Death-rate.
1876—1880	23·3	24·8	3·8
1881—1885	21·9	23·3	3·3
1886—1890	21·2	22·6	2·9
1881—1890	21·6	23·0	3·1
1881	21·8	23·2	3·4
1882	22·4	23·9	3·6
1883	21·9	23·3	2·9
1884	22·1	23·6	3·6
1885	21·1	22·5	2·8
1886	21·6	23·0	3·0
1887	21·6	23·0	3·3
1888	20·1	21·4	2·5
1889	20·3	21·6	2·9
1890	22·6	24·1	2·9

Re-calculation of Death-rates in Dublin, Belfast, and Cork.

Years	Dublin.			Belfast.			Cork.		
	Recorded Death-rate.	Corrected Death-rate.	Zymotic Death-rate.	Recorded Death-rate.	Corrected Death-rate.	Zymotic Death-rate.	Recorded Death-rate.	Corrected Death-rate.	Zymotic Death-rate.
1876–1880 ...	29·5	32·6	5·1	26·0	29·8	?	30·8	33·7	?
1881–1885 ...	27·4	30·3	3·1	24·7	28·4	3·5	26·0	28·4	2·9
1886–1890 ...	26·2	29·0	2·9	24·4	28·0	3·0	24·3	26·6	1·8
1881–1890 ...	26·8	29·6	3·0	24·5	28·1	3·2	25·1	27·4	2·4
1891 ...	25·5	28·2	1·7	25·5	29·3	2·6	26·9	29·4	1·4

It would be desirable to have a census taken every five years; but the great expense this would entail is a barrier difficult to get over. The greater number of the social facts collected for census purposes are not of great value as factors for determining sanitary progression or retrogression. It might be sufficient to have a mere count of the people every third year. There would be little clerical labour in connection with such a census, but the information gained would be of great use to the Public Health Authorities. A triennial enumeration of the population of Liverpool and Belfast would have prevented the extremely incorrect estimates made for so many years in reference to the birth and death-rates in those cities.

I have already stated that the results of past sanitary work encourages us to redouble our exertions to reduce the urban death-rate to at least that of the most healthy of our towns. If the 23 per 1,000 rate of the 28 great towns were reduced to 19, it would mean a saving of 380,000 lives in a single decade.

The recent reduction of the death-rate is most marked in the case of the infective diseases. Of these phthisis, or pulmonary consumption, is the most fatal. It kills about 50,000 people every year in England, and in Dublin it produces a death-rate of nearly 4 per 1,000 of the population, or nearly double the mortality caused by what are termed the principal zymotic diseases. Hitherto very little has been done to prevent this disease from being propagated from the infected to the sound. It is, however, a great advance towards the proper prophylaxis of the malady to know that its immediate exciting cause is a micro-organism. We must not be discouraged because of Koch's failure to kill the bacillus of tuberculosis; in time we shall be able to control its ravages, and perhaps to extirpate it altogether.

At the International Congress of Hygiene, 1891, Dr. Burdon Sanderson expresses his belief in the identity of bovine with human tuberculosis, and his conviction that it was sometimes transmitted to man by infected flesh and milk. Professor

Macfayden said that the milk of tubercular cows was a vehicle of the disease of no uncommon occurrence, and he mentioned that he found the microbe of tubercle in the muscles of the ox. By guarding against the use of infected meat and milk, by the constant destruction of the sputa of phthisical patients, and by the adoption of other measures preventive and remedial, it is to be hoped that the ravages of the disease may in time be largely decreased.

A valuable and suggestive memorandum as to the prevention of phthisis has recently been issued by the North Western Branch of the Society of Medical Officers of Health; it deserves a wide circulation.

Whilst phthisis shows a tendency to decline, typhoid fever holds its own and even increases in many towns, and indeed in the rural districts. I have ascertained that in 50 large towns in the United Kingdom typhoid fever caused 2·3 deaths per 1,000 persons during the years 1886-91. In Dublin the rate was 5, in Belfast 5·1, and in St. Helens 5·2 ; this last was the highest rate.

Whilst typhus fever, once so prevalent, has now almost ceased to exist, it is evident that the hygienic measures which have eliminated it and small-pox from so many towns—notably Dublin—have had little or no effect upon typhoid fever. It attacks rich and poor alike, and prevails equally in town and country. I have made especial study of the disease as it appears in Dublin, and have come to the conclusion, that there, and perhaps elsewhere, it is miasmatic, or earth born. In Dublin during the last 10 years, one person in every 144 persons living on clay soils has had typhoid fever, whilst one in every 92 persons located on gravels have contracted the disease. The disengagement of the micro-organisms of this disease takes place when the soils become dry, and this occurs more frequently in the case of loose gravels than of stiff impenetrable clays. To soil pollution I attribute the prevalence of typoid fever in these countries, and as a preventive against the disease, we must keep the underground air from entering our dwellings. We should be as particular with respect to the purity of the soils under and close to our dwellings, as we are with regard to the purity of the air which surrounds us. When all the organic *débris* produced in towns is quickly removed from them to a safe distance, when the dangerous subterranean atmosphere is prevented from entering our dwellings or even our streets, when sewage flows steadily day and night through well-constructed main sewers, and when our soils are thoroughly drained, and kept free from filth, then we may expect to see a substantial reduction in the mortality caused by typhoid fever and indeed by other diseases.

The high mortality of the working classes is in no inconsiderable degree due to the insanitary dwellings in which a large proportion of them reside. It is to the improvement of the homes of the artizans and labourers that we must chiefly look for a further reduction in the death-rate of towns. Two classes of houses are occupied by workmen and their families—one built specially for them, the other originally intended each for one family of the upper or middle class, but now converted into tenements, having from two to a dozen families each. The latter class of dwellings are often very old and dilapidated, and their woodwork honeycombed, their floors are sunken and patched, their walls damp owing to defective roofs, their staircases creaking and broken, their basement stories—formerly clean and well-kept kitchens—now noisome dark spaces, sometimes shut up to prevent them from becoming the asylums of homeless wanderers.

The houses built for artizans and labourers, by persons who only desire to make a profit out of them, are often very defective in construction and in the essentials of a healthy dwelling; their rents are generally too high for other than well-paid artizans. The benevolence of such men as Lord Iveagh and the late Mr. Peabody has provided dwellings of moderate rent, but unfortunately only a small fraction of the population can benefit by the generosity of these philanthropists. Many thousands of nice buildings for workpeople have been built by companies founded upon semi-philanthropic, semi-economic lines; but they, too, are generally let at rents exceeding 2s. per week. The houses which are the most insanitary, and in which the seeds of the fevers are nursed as in a hot-bed, are those occupied by the poorest classes—hawkers, the inferior kinds of labourers and porters, itinerant musicians, hangers-on about the markets, persons with no fixed occupation, poor widows, mendicants, the people who loaf about the streets (particularly in the neighbourhood of public-houses), the seedy persons "who have seen better days," &c. The rents paid, or promised to be paid, by these decayed, always miserably poor, people, are very small; and ordinary landlords could not afford to keep their dwellings in the state of repair, cleanliness and convenience which health requires, and indeed public safety demands. It is from these wretched abodes of the semi-pauper classes that the contagia of the infective diseases sally forth, to deal out disease and death amongst the people whose houses are in a fairly good sanitary state. It is not sufficient, therefore, to have our own houses in good order, we are interested, though of course not to the same extent, in having all the houses in our neighbourhood placed under healthful conditions.

For several years past Parliament has been enacting statute

after statute in reference to the improvement of the homes of the working classes; and the local authorities have now very large powers entrusted to them for the purpose of building dwellings for artizans and labourers. With respect to towns it seems to me that more has been done for the artizans than for the labourers. I think we should leave chiefly to the operations of the building societies and to private enterprize the providing of dwellings for artizans as they are fairly well able to take care of themselves; but if the money of the ratepayers is expended in constructing dwellings for the people who can only pay from 1s. to 2s. per week rent, then I say it is well laid out, because it tends to diminish sickness, death and pauperism. I know there are great difficulties, financial and other, in the way of substituting clean and moderately comfortable dwellings for the filthy dens in which dwell at least five per cent. of the urban populations. It is chiefly in such places that the criminal classes reside, and *they* would rather not be supervised by municipal officers. It is probable that a loss would be sustained by letting fairly comfortable and well-kept tenements at rents of from 1s. to 2s. weekly. Corporations can, however, borrow money at so low a rate of interest from the Government for the erection of labourers' dwellings, that if they adopt good schemes, they might provide very low-rent dwellings, without incurring much loss. In 1890 the Corporation of Dublin erected eighty-six dwellings for labourers. They consist of two-storied houses, each containing four tenements. There are nineteen of these let at 2s. per week. Each consists of a living room, 12⅔ feet by 12 feet; a bedroom, 10½ feet by 7½ feet; and a scullery and other accommodation exclusively belonging to the tenement. The rent derived by the Corporation from these eighty-six dwellings pays the annual instalment of the loan of money by which they were built, the interest on the loan, and a surplus of nearly £100 a year. The Corporation, who have not spent a penny of their own money on these dwellings, will in thirty-eight years become their owners, as the loan by that time will be repaid.

In contrast to the good value which these Corporation tenants receive for the small rent which they pay, I show in the following statement the poor accommodation afforded to room-keepers in tenements let by house jobbers. In four streets (Church Street, Upper Mercer Street, North Cumberland Street, and Jervis Street, Dublin) I ascertained that 1,074 families resided in 170 houses. They occupied 1,482 rooms, less than one and a half rooms per family. The annual rent paid by the tenants was £8,311 13s., though the valuation of the 174 houses for rateable purposes was only £2,677 10s. The average weekly rent per family was 2s. 6⅗d. in Church Street; 2s. 8d.

in Mercer Street; 3s. $4\frac{3}{4}$d. in Cumberland Street, and 3s. $8\frac{1}{3}$d. in Jervis Street. These figures show that in Dublin at least the rents of the dwellings of the working classes are far in excess of their real value.

The education of the people in sanitation ought not to be confined to limited sections of society, but should be carried out as one complete and well graduated system for the instruction of the whole Nation. A study of the laws of health should form part of the system of primary education, and would be at least as interesting to the youthful mind as a study of the "three R's." The character and conduct of the man are mainly dependent upon the education and training of the child; so also in the future nation its action and progress will be the product of the education given to the actual nation in its infancy and youth. The sanitary lessons which are now being taught to the British people will bear good fruit in the century which is close at hand —the century, let us hope, of low and uniform death-rates.

We are living in an epoch when man is earnestly striving for a higher and better life—when, perhaps, more than at any previous phase of his history, he subordinates the baser instincts of his nature to its higher and nobler attributes. Yet there are not wanting those who view with indifference or scepticism the efforts which man makes to purify himself, morally and physically. These pessimists, or realists, as they love to call themselves, can see nature only in its darker side. They paint the horrors of the plagues, the carnage of the battle-field, the devastation of the earthquake and volcano, the destructive action of the tempest, the sufferings of the sick and dying, the long hours of toil, the intolerable evils of poverty, the miserable struggle for existence. They parade all the evils which afflict man—they review all his inherent failings, defects and vices. They grimly and passively await the moment when they must shuffle off their mortal coil, and like their meaner fellows in creation, commingle in the inevitable dissolution.

Fortunately for human progress these realists exercise but scant influence on the destiny of man. They seem to forget that the days of health out-number the hours of sickness; that we rejoice infinitely more than we mourn; that love preponderates over hate; that there is more happiness than misery; that even pain has its uses, as a preserver of life, as an incentive to pity.

Better far is it to look upon the bright side of nature and to appreciate the beauties of this glorious world of ours, with its towering mountains; its billowy seas; its magnificent forests; its vast expanses of emerald green; its innumerable forms of animal and vegetable life; its harmony of colours; its vast dome of sky, with glittering stars and golden orbs of light,

Surely ours is a world well worth living in,—a world of joy and beauty, which well may inspire us to look from nature up to nature's God; a world of which the poet says:—

> "The poetry of earth is never dead
> When all the birds are faint with the hot sun,
> And hide in cooling trees—a voice will run
> From hedge to hedge about the new-mown mead."

Many of the evils which the pessimists believe to be irremediable are in reality within man's power to lessen or destroy. Not a few of them arise from systematic violations of the laws of life and health. We can hardly be clean in our minds if we are foul in our bodies. We should keep corruption as far from us as possible. Let us dwell in the freshness of things, remembering always that filth is synonymous with disease and death. Let us worship at the shrine of that goddess who has given a name to the noblest of the sciences—that which relates to the preservation and improvement of that precious porcelain of man's body. Hygeia is depicted as not only beautiful but strong and vigorous, typical of what the human form ought to be. A great American poet says of her:—

> "The leaden footsteps of care
> Leap to the tune of her pace,
> Fairest of all that is fair;
> Grace at the heart of all grace!
> Sweet'ner of hut and of hall,
> Bringer of life out of naught—
> Hygeia, oh fairest of all
> The daughters of time and thought!"

SECTION I.

SANITARY SCIENCE & PREVENTIVE MEDICINE.

ADDRESS,

By Prof. J. LANE NOTTER, M.A., M.D., D.P.H.

PRESIDENT OF THE SECTION.

My first duty to-day is to thank the Council of The Sanitary Institute for the honour they have conferred on me in inviting me to preside over this section of the Congress.

It is an honour which I wish had been placed in abler hands than mine, and I must crave your indulgence for a short time while I offer a few observations on the causes and prevention of cholera, a disease which threatens in its onward march to visit our shores, and that at no distant date.

There is a certain area, bounded by more or less definite limits, wherein cholera is always endemic in India. This is comprised between the base of the Himalayas on the north, and the Bay of Bengal on the south; the north-west and central provinces on the west, China and northern Burmah on the east. Within this area is located the delta of the united waters of the Ganges and Brahmaputra. Whether this is the only endemic area is a question which I shall have to refer to again. And here let me briefly review the climatic state of this region. Traversed from north to south by the most uncertain and most impetuous river in the world, Bengal proper, or the true delta of the Ganges, is a mere alluvium, deposited, as it would appear, in a vast estuary, into which this great river poured forth his earth-laden water.

History tells us that within a comparatively short period this river has wandered out of one course into another, throughout an extensive tract of country, nearly every part of which has in consequence been left, virtually, in a condition of newly deposited land. Floods and heavy rains leave this flat and

rivulet-broken soil in a condition of moisture, with the most profuse vegetation in the damp season, while during the long season, in which scarcely one drop of rain falls, the thin layer of loam covering the vast sand-bank of which the country is composed, becomes almost entirely destitute of moisture.

Throughout nearly the whole of the year there glares down upon this plain the almost vertical blaze of an inter-tropical sun. One can well understand that here an opportunity is afforded for the development and maturation of micro-organisms amid the dense vegetable and animal products exposed to every influence that most favours decomposition. And it was from the inundated rice-fields of Jessore, lying on the borders of this tract, that arose in 1817, as an epidemic, the plague of cholera which is again manifestly gathering fresh energy as it proceeds on its westward course.

Let us now pass on to some of the conditions favourable to the origin and spread of this disease.

It may be laid down as an absolute rule in reference to cholera that its epidemic occurrence in any one place implies, besides importation of the contagium, certain local conditions, these being:—

(*a.*) General sanitary defects.
(*b.*) Peculiarities of climate.
(*c.*) Peculiarities of soil.

The history of epidemics in India and in Europe teach us that universally filthy surroundings accompany outbreaks of cholera all over the world, and it can be readily understood why it is next to impossible to control an outbreak where such favourable conditions exist for the development of an epidemic after the importation of the seeds of the disease. This holds good for cholera wherever we meet it. To anyone acquainted with Eastern habits it is easy to conceive how any infectious disease is conveyable by water, or by milk adulterated with it. With hardly any exception in Eastern cities the drinking water is subject to all sorts of contaminations, and in villages is little better than diluted sewage. As to any system of conservancy outside the principal towns and cantonments there is none.

Those who have visited Kashmir, where cholera has recently been raging, can easily understand an epidemic occurring there. Srinagar, the capital of the state, has no sewers, but rivulets of water flow down the open gutters into which are passed the night soil and other filth of the population, except such as is, still more unfortunately, thrown into open cesspools in back-yards and areas, which become nests of infection. The water supply is taken from the river banks where it receives the sewage of the town.

If filth alone could *create* cholera Srinagar would breed an epidemic every summer; but surface sewage, narrow filthy streets, and a polluted river offer a ready and fertile hot-bed for the propagation of this disease when once imported.

Wherever there has been a recurrence of cholera the same monotonous conditions exist; revolting contamination of the drinking water and the utter negligence in the disposal of excrementitious matters. And while we in England trust to sanitary measures for protection against the invader, the question asked is: are we safe in depending on such means of protection as we have as yet enforced? Have we no unhealthy quarters in our crowded cities which the mass of the population resort to for labour, and for the excitement incidental to city life? Have we no defects in our drainage systems and methods of removal of animal waste? Is our water supply above suspicion? Is not the aggregation of human beings on limited areas a source of danger, and especially so when among those are numbered the idle and dissolute, the loafers, the street arabs, and casuals, who congregate in certain quarters and huddle together in foul rooms—unfortunates who cannot escape the results of their physical organization?

And if such is the case are those who are officially responsible for watching over the public health doing all they ought to do to afford us protection. We have abolished quarantine—and I think wisely—and have thrown the gates wide open to every invader. Can we prove that we may have reliance on such measures? that there are no weak points in our sanitary administration?

With the full knowledge of the responsibility attached to the position I hold as your President, I would earnestly and in all seriousness impress on sanitary authorities the importance of setting their house in order, or surely there will be a deadly reckoning to avenge for past neglect. It is true that in this country people have been provided at a vast cost with some of the essentials of a healthy life, but it is equally true that in our large cities the "bitter cry of outcast London" is, in some respects, as applicable as it was nigh fifty years ago.

> "Is it well that while we range with science glorying in the time,
> City children soak and blacken soul and sense in city slime?
> There the master scrimps his haggard seamstress of her daily bread.
> There the single sordid attic holds the living and the dead.
> There the smouldering fire of fever creeps along the rotten floor,
> And the crowded couch of incest in the warrens of the poor."

As regards climate in the non-epidemic areas, the epidemic spreading of cholera occurs during the rainy and warm seasons.

I shall endeavour further on to show what factors specially are concerned in producing variations in the amount of cholera. There can be no doubt that a relatively high temperature favours the production of cholera. Warmth, and up to a certain degree moisture, are the physical conditions which, combined, above all others foster the development of the specific poison.

The last condition, namely, the peculiarities of soil which favour the spread of cholera is not by any means the least important factor.

We find that from the earliest records of the disease a remarkable fact has been noted, viz.: That cholera has always attained its widest diffusion and its greatest intensity in those localities which are distinguished by a certain physical soil character, namely, permeability to water and air, and on those kinds of rocks which have a large capacity for retaining the moisture which has fallen upon them.

A careful study of the literature of the disease indicates that in considering the incidence of cholera upon any particular soil, it is not the geological character of the soil itself, but the saturation dependent thereon in which the true explanation of this phenomena is largely to be sought, but even this does not cover the whole case, for it again is affected by the soil heat, rainfall, sub-soil water level, soil air and the general climatic influences, to say nothing of the nature and quantity of the organic matter in the soil.

There appears to be no doubt that a relatively high temperature, both of air and soil, materially favours the production of cholera; in the case of air, this is not shown so much by the prevalence of the disease at times of maximum temperature, as in the absolute abatement or extinction of an epidemic with a fall in atmospheric temperature.

On the other hand from facts which have been slowly and laboriously collected, concerning the soil temperature in various parts of India where cholera is more or less endemic, we find that a high temperature of the soil corresponds differently, yet more closely with the course of cholera prevalence than does that of air.

The credit of the earliest and most systematic attention to this point belongs to Lewis and Cunningham, who in 1876 made a most valuable series of observations on soil temperature in Calcutta. They found that at a depth of six feet from the surface a soil heat of between 78° and 79° Fahr. corresponds with the maximum prevalence of cholera, and that the soil temperature at Calcutta is higher than that of the atmosphere during the cold season. More recent observations in the Punjab, by Firth, confirm Lewis and Cunningham's results.

So much for soil heat; but as concerns soil moisture, as affected by rainfall, we find that in Calcutta, as well as in all endemic areas, the maximum of cholera falls in the dry season (October to May) and more particularly in that part of it which is at the same time the season of greatest heat (March to May).

In the non-endemic area we find some points of resemblance and some of contrast to those offered by the endemic area.

The more the whole history of cholera outbreaks both in India and elsewhere is studied, the more hopeless seem the inconsistencies in its behaviour with reference to rainfall and soil moisture.

They will appear less glaring however and become more intelligible if it be borne in mind that rainfall as a causal element is purely indirect through the soil. Soil moisture is not only a question of so much or so little rainfall, but also of the physical character and saturation point of the soil, to say nothing of the state and level of the subsoil water. It is obvious that when the subsoil water level is low, copious rains will produce an effect quite different from that of moderate rain when the subterranean water level is high, and *vice versâ*, and that this result again will be further varied according as the soil is a highly porous one (sand) or a moderately porous one (loam or marl).

Chiefly owing to the writings of Pettenkofer much attention has been given to this question of subsoil water level and its bearing on cholera prevalence, particularly in India, where Lewis and Cunningham made systematic observations for eight years in and around Calcutta.

Their work on the whole showed that in Calcutta the prevalence of cholera is associated with a low level of the soil water. Observations in India go so far as to show also that where the water level is high, no marked outbreaks of cholera occur.

The subsoil water level must be looked at in the light of an index to the changes in soil humidity, from mere moisture to actual saturation of the overlying soil strata, as well influencing the question of soil ventilation. In regard to this latter factor, although our methods of estimating it are imperfect, and with reference to non-endemic localities our data are meagre, still, in the true endemic area, as Lewis and Cunningham indicated, degrees of soil ventilation seem to bear a direct relationship to cholera prevalence, and moreover, as will be shown subsequently, offer a clue to the connection of this disease with soil.

A careful analysis of the writings of Lewis and Cunningham, Pettenkofer and others, based on evidence gathered partly from the endemic home of cholera in Lower Bengal and other parts of

India, as well as from other countries in which the disease has prevailed as an epidemic, indicates to us that the only soil states which appear to bear any constancy to cholera are: (1.) Porosity and permeability. (2.) An average soil heat of 79° Fahr. at six feet deep. (3.) A low level of the subsoil water.

This clears the ground, somewhat, but it remains still to enquire what evidence is offered by the soil itself as to the existence of what all unite in considering does exist—the specific organic cause of cholera.

Elaborate microscopical examinations of soil from various parts where the disease exists, both endemically and epidemically, have been made, but mainly with negative results.

Notwithstanding the outcome of all research on these lines the consensus of opinion is in favour of the theory that the comma bacilli, so constantly found in cholera dejecta, are closely connected with the specific cause of the disease, even if they are not the specific cause itself.

Though the bacilli have been very rarely found in soils, yet many observations have been made regarding their behaviour in both water and soil. Dr. D. D. Cunningham, of Calcutta, made an elaborate series of observations on these points. All experimental facts seem to indicate that the so-called choleraic commas are extremely feeble in the struggle for existence when gaining access to ordinary soil and tend rapidly to die out. This question, however, is not quite so simple as this would seem; and is further complicated by the fact that the more one studies this subject the more convinced one gets that in all likelihood there is a plurality of species of comma-shaped bacilli, and that these do not behave uniformly in either water, soil or any other media. We may not be dealing with distinct species, but with races or modifications due to change of environment. As Dr. Adami has very recently stated, there must be some little latitude in our conception of species among the bacteria: we must be prepared to discover considerable variations in the properties of any one species. By a due appreciation of this dictum, it is probable that many experimental inconsistencies may be explained. The existence of more than one variety of comma in different cholera dejecta is probably dependent upon the very varying conditions of the individual patient's intestinal tract—analogous to the variation in symptoms and mortality of cases, as well as to variations in value of certain remedies in the disease. It is well known that in the present epidemic cases occur, which both in respect of symptoms and mortality must be regarded as choleraic, but in which the intestinal contents are devoid of cultivable commas, or indeed of commas at all. Such may be merely cases in which the commas have failed

to find intestinal conditions in which they could breed true: just as outside the body the same commas can, under the influence of artificial external conditions, assume important and more or less persistent morphological and physiological properties.

These considerations open up the whole controversy as to whether cholera commas in their life history undergo change in form and to whether they can assume a resting or spore stage, in which though overlooked and regarded as absent, their germs are all the while merely waiting suitable external conditions to renew their well known shape and effects. The more the life history of the comma bacillus is studied the clearer it becomes that this microbe is not one of the ordinary schizophyta, or if it be, then it is merely an evolutional stage of some higher organism, or what is not unlikely, a true parasite, existing in man and animals in one form and needing another hoste, possibly the soil itself, wherein to complete its life history.*

Experiments with various samples of soil show that choleraic commas do rapidly and completely disappear and die out from soil when such is kept for a period of about three weeks, either dry or absolutely saturated with moisture, or however dry or moist when exposed to a temperature below 50° F., or when mixed in soil with putrefactive matter or with a large excess of fœcal matter.

This incapacity on their part for continued life under such circumstances is apparently due to a want of oxygen, to excess of cold or heat, and to the presence of fungi and saprophytic forms of life hostile to them.

On the other hand, in moist states of the soil short of saturation, and in media, offering conditions short of those just enumerated, their inability to discover commas, as commas after a lapse of time, is no proof of the destruction and disappearance of the cholera germs, as these seem to be capable of undergoing morphological changes and of assuming a resting or spore stage, in which their duration of life seem to be indefinite, and from which on being transferred to more congenial soil—*e.g.* the alimentary canal of man and animals—they can assume active properties and powers.

In the *endemic area* the soil is probably the main if not the essential site of the processes and changes resulting in the production of the poison, which in man induces cholera. The soil concerned in these changes is, in all likelihood, that layer lying above the water level or the first impermeable stratum in

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* I beg to refer to a most interesting article on this subject by G. F. Dowdeswell, M.A., F.L.S., &c.—*Lancet*, July 28, 1890.

a locality and once seeded with the specific organisms, the development in the soil or diffusion from the soil depends on certain conditions of that layer.

These conditions are, permeability to air, a certain degree of moisture which must not be excessive, a mean annual temperature of 72° F., a moderate amount of contained organic matter and an absence of decomposing and putrefactive processes. Any locality presenting these conditions throughout the year may be said to be capable of affording an endemic habitat for the cholera organism.

It is quite possible, as Naegeli has pointed out, that excessive dirt in a locality may be an efficient cause for the prevention of certain forms of disease in it, the excess of saprophytic organisms tending to the suppression of more or less parasitic ones, but no one could regard it as therefore desirable to increase the accumulation of dirt.

Lower Bengal, as typified by Calcutta, fulfils the above conditions. Assuming that prevalence of the disease in that area is a fair test of production of the cause, we ought to find, if these conclusions are correct, that the amount of specific material developed increases with the mass of generating stratum: this is exactly what we do find, as the maximum and minimum of cholera prevalence in Calcutta coincides with the maximum and minimum of the water level—or, in other words, with the maximum and minimum of non-water-logged soil.

If we go a step farther and equally assume prevalence in the same area to be an index of diffusion, there are two main channels by which a material developed or harboured in the soil may reach human beings in ány locality: these are the water and the air occupying the soil interspaces. The phenomena of seasonal fluctuation in prevalence appears to fail, as far as the endemic area is concerned, to explain or support the idea of the water supply being the main channel of diffusion. Were it so, the maximum prevalence ought to occur at that period when the meteorological conditions are calculated to facilitate the entrance into the drinking water of materials derived from the bodies of those suffering from the disease. June, July, August and September are the periods when most material is washed into the tanks and drinking-water supplies in Calcutta, yet these are the months of minimum prevalence.

So too in May the rainfall is heavier than in April, yet instead of an increased there is a decreased prevalence, while in November more cases of the disease occur than in October, although the latter month presents greater chances of inwash of material by rain into the tanks and wells than the former.

If, however, we regard the air as the channel of diffusion by

which the cholera poison passes from the soil to the subjects of the disease, we find that the facts are different.

Exactly in accordance with that hypothesis, maximum soil ventilation occurs during March and April coincidently with the maximum of prevalence: and the minimum of soil ventilation occurs during the rainy season, which is the period of minimum prevalence.

Strong as is the evidence in favour of the diffusion in the endemic region, from the soil of the specific cause of cholera by means of soil air emanations and dust yet it does not cover all cases as shown by the lessened incidence of the disease on all places provided with a pure and good water supply. Calcutta is a case in point, the disease has certainly lessened there, but has not disappeared. The existence of a pure water supply has reduced the number of cases by reducing the facilities for the propagation of the disease by virtue of a wholesome drinking water being substituted for one polluted by the recent dejecta of the cholera-stricken. This experience without appreciably weakening the soil theory of the disease merely strengthens the belief that possibly both channels are at work, and that too great reliance must not be put on either the one or the other.

These remarks apply altogether to the endemic home of cholera. It must, however, be noted that it has been the custom for most writers when speaking of the facts concerning the occurrence of cholera outside the well known endemic area of Lower Bengal, to maintain that the nearer the soil of any district approaches in character and conditions to that constituting the lower part of the Gangetic plains, the greater will be the risks and likelihood that cholera will be found to prevail there.

It is very much to be doubted whether this is a sound statement, but rather that the tendency of the disease to prevail on all alluvial soils, especially near rivers, such as in the valleys of the Brahmaputra, the Nerbudda, the Tapti, the Indus, and Euphrates, is due to the fact that those districts are endemic homes of the disease equally with the Gangetic valley. I am inclined to believe that cholera is after all endemic in several parts of India, which at present are not so considered.

It is, however, certain that personal intercourse between infected and non-infected places in India, while undoubtedly accounting for a very large number of cases, is insufficient to explain or account for some of the remainder, which in the main can only be explained by regarding the disease as truly endemic in, hitherto, unsuspected spots, and only requiring the establishment of certain indicated conditions in their superficial soil to determine the production of cholera, the chief of these being a

drying zone of soil, always containing the specific material causative of the disease.

The soil appears to play a direct part in the production and diffusion of cholera, *only in the endemic areas;* outside the endemic area the soil strata appears to have nothing whatever to do with the disease, its appearance there is due to importation of the virus and its diffusion as an epidemic to sanitary defects. Soil and climate alone have not been observed to originate the disease in non-endemic areas.

"*On Tuberculosis; or, does Consumption arise from Flesh-Eating?*" *by* JOSIAH OLDFIELD, M.A., B.C.L.

DISEASES are produced in a great number of ways, but the chief methods of propagation are:—

Firstly, by the INHALATION of disease germs into the lungs with the air breathed, and thence by the blood stream throughout the body;

Secondly, by the INGESTION of disease germs, together with the food eaten into the stomach and intestines, and thence by osmosis or by the absorption by the lacteals and lymphatics, or through some abrasion of the mucous membrane by a species of inoculation, into the lymphatics or the blood stream, and thence over the whole body.

Of these two causes of disease, I believe ingestion to be far the more serious, for a number of reasons, of which the simplest perhaps is the fact that a person may go with practical impunity into the presence of contagious disease if he is careful to avoid swallowing his spittle, and does not eat or drink anything while exposed to the infected atmosphere.

There are two serious modes, therefore, of disease propagation, viz. (1), inhalation; (2), ingestion; and of these two the latter is far the more serious.

The discovery of a cause renders the search for a remedy much more simple, and so if disease comes in through inhalation and ingestion, its entrance can be prevented by ceasing to inhale and ceasing to ingest.

To stop breathing and eating altogether is a remedy perfectly simple in theory, impossible however in practice.

The next remedy that suggests itself, therefore, is the breathing *only* pure air and eating *only* pure food. When we consider them, however, we find that both these conditions are impossible. All those whose occupation takes them into the presence of sickness are often breathing impure air.

As we are often obliged to inhale unavoidably impure air, so too we cannot always ensure that our food is free from impurity; but we can aim at avoiding food which is manifestly diseased, and if we cannot altogether escape risk, we can at any rate avoid touching those forms of food which are specially liable to disease.

I purpose showing, with regard to the special disease under consideration—Tuberculosis—that flesh food is a food which, as a fact, is diseased to an enormous extent, and not being a necessary food, all arguments point to the avoidance of it as an article of diet.

Amongst the terrible diseases which curse humanity, Tuberculosis is perhaps the most terrible; there are others which may be more painful or more rapid, but none which are more hopeless and more pathetic; and yet Tuberculosis in one of its varied forms is one of the most common diseases, so that in some way or another it affects, or has affected, every other person we meet.

It must not be supposed that because the seat of Tuberculosis is usually the lungs that therefore it is caused chiefly by inhalation, because the experiments of Dr. Burdon Sanderson show that even where the bacillus is introduced by inoculation, *i.e.*, by subcutaneous injection, it at once locates itself and manifests its energy in the lungs. And in a research by Professor McFadyean and Dr. Woodhead they found that in 127 cases of Tuberculosis in children, it was the mesenteric glands which were affected in 100 cases, and these would be almost certainly reached through the organs of alimentation. And we may conclude that in these cases the disease was introduced by the milk from tuberculous animals.

Now with regard to adults, attention should be carefully drawn to the correlated facts that

(1) Tuberculosis exists in men to an enormously high percentage.

(2) Tuberculosis may be communicated by ingestion of tuberculous food.

(3) Animals used for food are, as a fact, infected with tubercle to an enormously high percentage.

(4) It is practically impossible to detect the disease when the meat is cut up and offered for sale.

(5) Tuberculosis in man may therefore be set down as arising

in a high percentage of cases from the ingestion of tuberculous meat.

(6) And finally, flesh is not a necessary part of the diet of man, and therefore in the face of the dangers with which its use as a food is connected, it is not less than suicidal to advocate an increase in its consumption, whereas the soundest policy is to agitate for its entire disuse under the existing circumstances.

THE BACILLUS TUBERCULOSIS.—

The *Bacillus Tuberculosis*, called so from its rod-shape (*Bacillus*=a little rod), is a micro-organism discovered by Koch in 1887, about 1-8,000th to 1-10,000th of an inch in length, and about 1-50,000th of an inch in breadth, *i.e.*, it would take some hundreds put end to end to reach across the eye of a needle. This micro-organism is of such vitality that it can stand a temperature of 107° for several weeks, and even one of 212° for some little time (say less than sixty minutes), before it is destroyed, while as to the spores it is at present impossible to say what amount of heat they can stand, so difficult is it to ensure their destruction; certainly the ordinary mode of cooking (which very often is not enough to coagulate the blood in the centre of the joint) is insufficient to destroy either the bacilli or their spores. Whenever a piece of flesh-meat is cut at the table and the inside is red and blood oozes out, there is one point quite certain, and that is that if there were any bacilli present they have not been destroyed.

These bacilli when they enter the body by any source, seem to get into the blood-stream, or the lymphatics, and thence are carried to the lungs where they apparently usually settle down, and for some time appear to be lost, but their action and growth though exceptionally slow is sure, and is akin to the action of the *bacillus lepri* (leprosy) and ere long we find tubercles appearing; it does not always follow that because we only find tubercles in the lungs that the disease may be called "local," because when a more careful examination is made they are sometimes discovered in the marrow before any great manifestation of them takes place in the lungs, and it must not be forgotten that there may be thousands of spores present, and yet they may not be able to be discovered in the field of the microscope, so very minute are they in comparsion to the corpuscles of the blood, or the tissues in which they may be located.

The bacillus propagates by fission and also by spores, and therefore, once it has managed to secure a permanent lodgment free from the attacks of the protective corpuscles of the blood, it keeps sending out host upon host to extend its conquest, and so the usual mode of progress is for a greyish deposit to be made

in the normal tissue, and then this caseates (becomes cheesy), and sometimes cretifies (becomes chalky), and sometimes passes into the condition of pus, in which the bacillus is specially active and rampant. It is also, meanwhile, throwing off a very poisonous alkaloid, which tends to reduce in an alarming degree the vital resistance of the body. This virulent poison contains the celebrated Tuberculin, and the power of this is well known; one millegramme of Koch's fluid, which contains 1 per cent. of the essential principle—that is to say, only 1-6,500th part of a grain of the tuberculin itself—is enough to produce high fever and considerable swelling, and it is, therefore, one of the most powerful poisons known. According as these bacilli or spores manage to find lodgment in the various organs of the body, so is a different name given to the disease—when they commence operations in the mesenteric gland, the disease goes by the name of "Tabes Mesenterica." When the brain is attacked we have Tubercular Meningitis, or water on the brain. When the lungs are the organs affected, and this is the most usual in the case of adults, it goes by the name of Phthisis or Consumption. When the joints or the glands become the seat of the mischief we find what is called a Scrofulous or Strumous state at once resulting. When it is the skin we have Lupus caused, while many cerebral and paralytic diseases apparently have their origin in the same terrible bacillus, so far extending and so potent is it in its power to injure.

Dr. Landouzy, member of the Academy of Medicine, and one of the Editors of the *Revue de Médicine*, says:—

"I shall never be weary of repeating at this moment of discussion on the depopulation of France, that tuberculosis of itself does more for the depopulation of our country than alcoholism, syphilis, and Malthusianism put together."

Tuberculosis may be communicated by Ingestion of Tuberculous Food.

It has already been shown that ingestion in general is a more serious form of disease contamination than inhalation, and that this holds good, as well for tuberculosis as for other infectious diseases.

It is quite true that the injection of the bacilli may take place in other ways than by eating of diseased flesh, and that they are so introduced into the system, is proved by the presence of consumption in a high percentage among people whom we may suppose are not exceptionally large flesh-eaters, *e.g.*, people exposed to an atmosphere laden with dust.

While the fact of tuberculosis, however, arising in other ways

is true, it is none the less certain that the ingestion of tuberculous flesh is a very serious factor in its dissemination.

Whatever may be urged about the power of the juices of the stomach to destroy disease germs, applies happily to all the cells of the body in a greater or less degree, and therefore if they were absolutely invincible, no disease of any organ could result by any means, for the cell attacked would annihilate the attacking disease germ, but it is because no organ of the body is able to withstand too often reiterated attacks upon it that the stomach also, though it doubtless destroys many nocuous living things that enter it, yet under certain conditions allows enemies of the body to pass its portal, and we have the demonstrations of Strauss and Wurtz distinctly to prove the inability of the gastric juice and the fluids of the alimentary canal to destroy the *Bacillus Tuberculosis;* the same thing is also conclusively shown by the fact that in the later stages of tuberculosis of the lungs, when there is not strength to expectorate all the phlegm, and so in consequence part of it gets swallowed, tuberculosis of the intestines often follows.

The only other possible objection to the position that tuberculosis is disseminated by eating diseased flesh, is that cooking destroys the bacilli.

This undoubtedly is true; there is no animal or vegetable life known which cannot be destroyed by raising its temperature sufficiently high. But what meat is so cooked that all its substance is raised high enough to destroy the bacilli of tuberculosis? We have seen what they can stand (but how much more their spores can stand we do not know), and there is no living flesh-eater but will acknowledge that flesh-meat is constantly eaten which is still red, in which even the blood is not coagulated, and that the greatest proportion of the flesh eaten has not been exposed to the same heat in the interior of the joint as it has on its exterior.

Animals used for Food are, as a fact, Infected with Tuberculosis to a very high percentage.

The issue has now been reduced to this point, that flesh-eating is a serious cause of consumption if the flesh of cattle be tuberculous to any appreciable extent.

There are two points here which have to be faced: (1) Are the internal organs often diseased? (2) Even though those organs be so diseased, is the flesh thereby affected, or is it sufficient to remove the diseased organs and use the rest of the carcase for food?

In the great Glasgow case, which was tried before Sheriff Berry in May and June, 1889, extracts from the evidence of

Professor Walley ran as follows: Commencing question 2476.

"And if an animal was not fit for human food you would not allow it?"

"You will understand that I am the Inspector for the Privy Council, but I have nothing to do with any disease unless it is under the Contagious Diseases (Animals) Act, which tuberculosis is not."

"And you tell us that the cow was so bad that, apart from all disease, you would have condemned the carcase?"—"Yes."

"You allowed the animal to pass in such a state?"

"I allowed it to pass because it had no pleuro-pneumonia. I had no power to interfere."

In Dr. Imlach's examination an extract was read from a published article of his, which was as follows:

"Cattle kept solely for dairy purposes, and particularly in large towns, suffer by far the most severely from this affection (tubercular phthisis). Constantly confined in stables which are not always well ventilated and clean, deprived of exercise, drained of milk in large quantities, and fed on the kind of aliment which most favours the increase of that fluid, though it may not enhance its quality, it cannot be wondered that the nutritive functions of the cattle so treated must suffer to a serious extent. Indeed, it is a matter of daily observation that the cows which are abundant milkers are most liable to this disease."

Q. 4734.—"You are the medical officer of health for the town of Hull?"—"Yes."

"What do you do in cases of tuberculosis?"

"We pass animals affected with localised tubercle of the lung in the first stage."

"Suppose the tubercle affects more than the lung?"

"We pass the carcase as fit for food."

Q. 5064.—"Is tuberculosis a common disease in milk stocks in and about Glasgow?"—"It is."

By the kind invitation of Professor Wynter Blyth, I accompanied him and some representatives of the College of State Medicine to inspect the slaughter-houses at Deptford.

As it is well known this is the great point for the import of foreign cattle. Every facility is here provided; there is no slaughtering in the early dawn or in the gathering gloom of evening to escape the eye of a possible inspector. Everything is done at fixed hours, and every beast is kept several days after landing, and has to pass under the inspector's eye before being allowed to be slaughtered. Everything is simple and straightforward, and collected within a narrow focus, which makes it perfectly easy to be thoroughly supervised—so different from

the scores of private slaughter-houses scattered hither and thither in the ordinary inspector's wide district. All the meat goes up from Deptford, too, to the Central Meat Market, and is there again inspected. What more would you have? Is not this a sufficient guarantee that meat killed at Deptford is at any rate free from the possible taint of Tuberculosis?

Not at all. Let me explain why.

The following few questions and answers show where the screw is loose, and tell the same old tale of non-immunity from tuberculous meat.

"Everything landed here is inspected, of course?"

"Oh, yes, not an animal passes but what has been inspected."

"What are they inspected for?"

"For? 'Foot and Mouth' and Pleuro. They've been very strict till just lately again, owing to the outbreak of the 'Foot and Mouth.'"

"For anything else?"

"No, nothing else, unless there were any infectious fever."

"Not Tuberculosis or Actinomycosis, I suppose?"

"Oh, no, the inspector has nothing to do with that."

Thus so far the tuberculous animal passes on unchallenged.

"When they are slaughtered is there an inspector present?"

"Oh, no, we are slaughtering all day, the inspector has nothing to do with that."

"He doesn't see the slaughtered carcases, then?"

"Oh, no, that's all done at the Central Meat Market."

Now carefully note the next replies in the light of the fact that once the internal organs are removed, and the carcase stripped and dressed, it is almost impossible to detect Tuberculosis, even in cases of an advanced and terribly dangerous character.

"What is done when the animal is killed?"

"It lies a little time on the floor to bleed; is then skinned, the intestines and all the internal organs taken out, dressed and carried to the refrigerating chamber, where it remains inside about twenty-four hours to harden, and is then sent up to the market."

"And what becomes of the internal organs?"

"Oh, they are contracted for and are carried away."

"Are they not inspected?"

"Oh, dear no, we have nothing more to do with them."

And this is the state of affairs in the model slaughter-house of Great Britain!

And people will hug themselves under the delusive belief that their meat has been inspected, and that "good" butchers never get diseased meat.

There is abundant evidence to show that to-day our breeders breed tuberculous animals, our feeders rapidly fatten-up animals which have become tuberculous from long lactation or other causes, that our butchers purchase (sometimes honestly and ignorantly, and sometimes knowingly and purposely) these animals privately or in the open market, and they are slaughtered in private sheds and slaughter-houses, in villages and towns alike, under no supervision, that the carcases are "stripped," and the internal organs, if *badly* diseased, are otherwise disposed of, and if not *very* badly gone are sold in cheap shops or give substance to highly spiced sausages, while the remaining portions of the animal in which the disease is unable to be detected except by a microscopical examination—which it never gets—are distributed far and wide, and appear equally as sirloins on the royal board or as tripe in the peasant's hut.

The great struggle as to the danger of tuberculous meat has been fought over the question of "general" or "local" Tuberculosis. On one side it has been urged that when the disease is restricted to a small area of lung surface the rest of the carcase is in no way affected, and if the affected organs be stripped away the flesh of the animal may—and for economical reasons should—be used as food and not destroyed; while the other school has consistently maintained that the presence of a tuberculous deposit, however small, proves the presence of the specific bacillus, and that to enable this lodgment in the lung to have taken place, the blood stream or the lymphatics must have been passed through, and therefore probably contain others travelling on the same road; and, moreover, the fact of tuberculous deposit means an active presence of bacilli, constantly multiplying by fission and spore at an enormous rate, and sending out these offspsings by hosts into the blood stream, and thence over the whole body, so that the presence of a trace of tuberculous deposit renders the risk of partaking of any part of the animal so great, that the whole carcase should be at once condemned.

There is a *via media* which seems to me to contain the truth, and it rests on the fact of the wonderful power of the organism to protect itself, when it is unable to destroy or eject an invading foe, by encysting it or walling it up, so that eventually it is enclosed in a prison and is quite cut off from the busy life which is going on all round it. A good illustration of this is shown in the case of tuberculous warts which butchers sometimes get on their hands from *handling* the tuberculous meat. (This is the same meat which other people *eat* and so get tuberculous lungs.)

It often happens that in such cases the wart remains quite

local, and becomes so encysted from the blood stream that this is the only point where the disease exists. But these are comparatively rare cases.

At the earliest stage of lung tuberculosis it is impossible to say that the disease is "local," because whenever tubercles appear in the pleura, they must have come there through the blood stream, and therefore, the blood stream is diseased, and with a diseased blood stream the whole body may be, or may at any moment become, diseased.

I want to point out, therefore, two results of this, the first is that the term "local," as meaning harmless as to the rest of the carcase is misleading, because it is impossible to say at any moment that the bacilli are restricted to the tubercle which they have caused; the second is that by "stripping," only such organs as the pleura are removed, while the blood vessels which pass through the whole of the body remain and the lymphatics into which the bacilli apparently very early pass, cannot be removed, as they are for the most part surrounded by fat and stowed away all over the body.

The position I have taken up is the one to which the latest studies in bacteriology seem to tend, and it is a significant sign of the recognition of this, that at the proceedings of the North-Western Branch of the Society of Medical Officers of Health held at Manchester, on May 20, 1892, after a discussion on a Paper by Dr. J. Anderson, entitled, "Tuberculous Meat and its exclusion from the Meat Market," the following resolution was unanimously agreed to:—"That the flesh of any animal affected with Tuberculosis, to however slight an extent, is, in the opinion of this Branch, unfit to be sold for the food of man."

The conclusion, therefore, seems to me to be beyond dispute, that under existing circumstances, the eating of flesh food in any form is inimical to the health of the community as being a great factor in the origination and spread of consumption.

The President of the Section (Prof. Lane Notter) said the Institute was not responsible for the views expressed in the Papers. They simply expressed the views of the writers. The advantage of such papers was that they afforded a groundwork for discussion, and each one had something to learn. Their value could not be over-estimated.

Sir Charles Cameron (Dublin) said they had listened with very much interest to an undoubted lecture on Vegetarianism in disguise.

It would have been just as well to discuss in this paper all the diseases that were derived from the animal kingdom by the consumption of the flesh of animals. He gathered from the paper that they were likely to be emancipated altogether from this enemy of the human race, tuberculosis, if they abstained from eating animal flesh, but still it was a curious fact that the very animals which appeared to abstain from eating the flesh of other animals were not exempt from tuberculosis. It was curious that cows, which were strictly vegetarian animals, should suffer so terribly from this disease. If they carried the author's doctrine to its logical conclusion, they might just as well say that because cholera and other diseases were obtained from drinking water they should give up water drinking and take to whiskey or porter and such like things. What would become of the grass? The only known individual who partook of that commodity was the celebrated eastern monarch, he (Sir Charles) was not aware of any other person having been turned out to graze in pasture. But joking apart, for it was no joking matter, there was a great deal of truth in what the essayist had said with regard to the flesh of animals, but he thought Mr. Oldfield had somewhat exaggerated the amount of tuberculosis derived from that particular source. He knew of many places where this disease is rife, although the people were enforced vegetarians. There were many districts in Ireland where tuberculosis was the most fatal of all diseases, and yet the only animal food the people took was bacon, an extremely long time in pickle, and which had been very well cooked. On the other hand there were well-to-do people who ate plenty of meat, and yet they did not get tuberculosis to a greater extent than poor people who ate very little flesh. He hoped the essayist would not think that he differed from him altogether, because there were many things in which he agreed with him, although he could not go with him in his argument for abstaining from meat altogether. He quite agreed that where an animal's flesh was affected with tuberculosis it was the duty of the officer of health to say that it should be confiscated. That was the custom in Dublin. If the flesh was in any way apparently affected they never by any possibility allowed it, or any part of it, to be used as human food. In the abattoir which the Corporation of Dublin had erected, and in which the carcases of animals were minutely examined, and in which it was no one's interest to allow anything bad being passed, they had found that the percentage of cases of animals affected with tuberculosis was very small indeed. Therefore, for the remedy they must look for greater vigilance in the examination of private slaughter-houses, and the compulsory placing of all abattoirs in towns under the control of the local authorities. That was all they could reasonably do, for it was not reasonable to say that because one person in ten thousand was affected with tuberculosis through taking meat that all should abstain from flesh eating.

Mr. Washington Lyon (London) said the essayist's remarks about the slaughter houses at Deptford were quite true. There the animals

were landed, killed, and the meat sent to the Central Market, where it was inspected and if bad seized. He himself had seen meat condemned there. It was then thrown into a tank with a chemical solution that prevented its being used as human food. It was then taken away by a contractor and destroyed. As far as the City of London was concerned everything possible was done to prevent diseased meat getting into the market. He (Mr. Washington Lyon) agreed with the President that it would not do for all to become vegetarians. He did not think they need go away from this meeting frightened, but confident in what was being done by the Sanitary authorities in the United Kingdom, such as in Dublin, Manchester, Liverpool, and other large towns, who were taking this matter up for the public safety generally. But even if diseased meat got into the market he could not believe that there would be much harm done if eaten, after it had been cooked in 212 degrees of heat. Another point to consider was that if steam under pressure was used for cooking purposes they could get an amount of heat which could be obtained much beyond 212 degrees. He was, therefore, quite sure that this would be enough to destroy any dangerous germs in diseased meat.

Dr. Armand Ruffer (London), who said he spoke not as a Medical Officer of Health but as a pathologist, had made a large number of *post mortem* examinations of those who had died from phthisis, and he was sorry to state that he disagreed entirely with Mr. Oldfield. Before he could be justified in drawing these conclusions Mr. Oldfield should have explained how it was that in making *post mortem* examinations they so seldom found a case in which a patient had died from phthisis as the result of having taken tuberculous food. He did not remember having come across more than five cases of adults in which he could have said "this person may have died through tuberculosis contracted in taking tuberculous food." In the case of children it was different. When a man was inoculated with tuberculosis, the first thing to be seen was a primary or local reaction, and from the glands the disease spreads over the whole body, although it might skip an organ here or there. If it began at the apex of the lungs, it spread downwards, and then gradually all over the body. In all examinations of cases of phthisis they always found, if it was a case of long standing, that the patient had phthisis of the lungs a long time before he had it in other parts. With children it was different, and in them it was the drinking of milk that was the great danger, as it was in its milk that the real danger of the tuberculous animal lay. The bacillus tuberculosis was a micro-organism, which could be killed by a very moderate degree of heat, and if people would only cook their meat properly and not eat it half raw, there would be practically no danger from eating tuberculous meat. He believed that one bovine animal out of seven was affected more or less from tuberculosis, and it seemed to him that they should not condemn those animals simply because there were bacilli in the internal organs which were not eaten as no tubercle-bacilli had ever been found in the meat. He thought the danger of

ingestion of disease-germs by eating meat had been largely exaggerated, the great danger of tuberculosis being spread by animals lay in the milk, and not in eating their flesh. In his opinion, too, for every person who died from ingestion of meat, hundreds died from being inoculated by contact with human phthisical patients. If they went into a hospital they found that the patients who had died from phthisis had lived or had been in immediate contact with persons who were themselves suffering from phthisis. Phthisis had been proved to be catching, and every death from phthisis might be avoided, for every case was a case of infection. People should be taught that phthisical patients were a source of danger. Medical men should impress this on their patients, and not allow them to be a centre of infection for their fellow-men.

Sir Thomas Crawford, K.C.B. (London) quite agreed with all the last speaker had said. One thing had not yet been touched on, and that was the result of their experience in sanitary work. During the last fifty years it had been impressed on them that if the people of this country would be free from phthisis they must live in pure air. Formerly their soldiers were crowded in barracks, and this disease was a common ailment. Dr. Parkes and other medical men had impressed upon the authorities the necessity of giving the men abundance of fresh air in their dormitories, and when that was done they had the pleasure to report a steady and continued decrease in phthisis. He hoped they would keep those views in the forefront, and proclaim that where there were large bodies of men crowded in one common ill-ventilated lodging, they had a potent factor of consumption—foul air.

Miss Yates (London) wished to point out that vegetarianism claimed that abstinence from eating flesh was only a negative portion of the cure for consumption. The diet they recommended was a preventive against its being acquired. They claimed that the foods they advocated would enable persons to retain their bodies in such a healthy state that they would be able to resist the attacks of the bacilli. Grains and fruits contained a large proportion of the phosphates that all physicians agreed are of utmost importance in the consumptive diathesis. People of consumptive tendency were unable to digest oily or fatty substances, and vegetarians claimed that the diastatic principles contained in grain were a great aid in enabling people to digest, and assimilate fat, which they could not do under ordinary conditions. Therefore, on those grounds alone, they claimed that their diet would enable a person to repel attacks of this disease. It was stated that if diseased meat was cooked at a great heat it could be taken, but meat in that condition would be repugnant to a refined taste even if it were harmless, and why should people eat it when better food could be procured without any taint of disease. It was asked, therefore, that vegetarian food should be adopted, as it would enable consumption to be resisted as well as numerous other diseases to which so many were subject.

Dr. J. C. Thresh (Chelmsford) said that the same subject was discussed at the Conference of Medical Officers of Health on the previous day, and a resolution was then passed expressing the opinion of the meeting that where tuberculosis of a single organ of the body is associated with impairment of the nutrition of the flesh the whole animal should be condemned. On the other hand at a similar conference recently held in the north of England a resolution was adopted recommending the destruction of the whole carcase if only one organ were affected, whatever the condition of the flesh. For one conference to suggest one thing, and another a different one, naturally had a prejudicial effect upon the mind of the public. He thought, to condemn the whole animal for the slightest trace of tuberculosis was an extreme measure.

Dr. J. F. J. Sykes (London) insisted that the assertion that the mere abstinence from meat would prevent tuberculosis was fallacious, and the section must not allow it to go forth. It was a question of air as well as food. Sir Thomas Crawford had testified to the effects of air-borne contagion, and he (Dr. Sykes) was most anxious that no half-statement should lead to a wrong conclusion. With reference to Dr. Thresh's remarks as to the opinion expressed by the medical officers of health at their conference, he thought the section should not go so far as to condemn all food which was in the slightest degree affected with tuberculosis. He was of opinion though that there were many ways in which meat condemned as human food could be used. In Berlin, for some time past, tubercular food condemned in the public abattoirs was placed in a Rohrbeck disinfector. This was a steam disinfectant chamber in which the meat was placed after being cut up. Steam was driven through it, and maintained in the chamber under intermittent pressure. By this method it was made useful cooked food for animals, and it could be safely used for that purpose. This, he thought, was one of the most practical methods of utilising condemned meat.

Mr. J. Oldfield (London), in reply to Dr. Sykes, said he did not state that for a man to abstain from flesh eating would be a cure for consumption. This paper was entitled "Flesh eating *a* cause, not *the* cause, of consumption." It was one cause, and he maintained it was a very serious cause, but he would be sorry to say that it was the only cause. He didn't deny that there were other causes, such as tuberculous milk and limited supply of air, but he maintained that meat was one cause and he wanted to keep to that one cause, and to bring before the Conference that meat was a very serious cause of consumption. As to Sir Charles Cameron's joke about the great man of Biblical fame who was turned out to grass, it was worth while remembering that he got cured of his madness by his change of diet. Now he (Mr. Oldfield) did not mean to infer that people would be cured of madness by being turned out to grass, but he did say that consumption would be diminished by eating grain and such kind of food. He wished it to be remembered too that after the internal

organs had been removed it was impossible to tell whether meat was or was not tuberculous. At Deptford the internal organs were removed and the meat was then sent to the London market, if then found to be diseased it was destroyed. Professor Ruffer had asked how far it was possible in making *post mortem* examinations to find cases of tuberculosis due to eating tuberculous food? He could not answer that, but he said that in that room every fourth person would die of tuberculosis affection, so that it was too serious a matter to be trifled with. That was the first point in his paper. His second was that all animals were infected to a large extent with tuberculosis, and his third point was that consumption could be communicated by ingestion of tuberculous food. Then with regard to milk. He did not raise that question. What he said was as to meat, and milk was therefore, outside of his argument. As to the point can the bacillus be killed by cooking? He said it could, and his paper said it could, but what he contended was that it was *not* killed by the ordinary cooking. If meat were cooked so much as to ensure the bacillus being killed, it would be tasteless, and people would not care for it. It would destroy the flavour. They did not find herbivorous animals suffering from tuberculosis in their natural state. It was not until they had been stall fed, and subject to continuous lactation that they became liable to the disease. They hardly ever found wild herbivorous animals, on the plains of America for instance, suffering from tuberculosis. Professor Ruffer had pointed out that living with those suffering from consumption was a cause of the disease, but this only emphasises the point claimed; for it was the sputa, becoming dry, getting into the air and so settling on the food swallowed that caused the spread of the disease. Therefore, living in houses with consumptive people, where there was a possibility of food becoming infected by the sputa, bore out his contention—that it was chiefly ingestion which caused the disease.

The PRESIDENT of the Section said they were much indebted to the writer of the paper for bringing the subject forward, as it had elicited many eminent opinions on the matter. No doubt any resolution the section thought judicious would be passed by the Council. If they recommended for adoption a resolution for the total abolition of all private slaughter houses, this would be going to the bottom of the whole question. All slaughter houses should be placed under the supervision and control of the sanitary authority, and private slaughter houses, except in remote districts, abolished.

Mr. J. OLDFIELD (London) said he would propose "That this section is of opinion that in towns with a population of over 20,000 inhabitants, private slaughter houses should be totally abolished, and be superseded by public abattoirs under the control of local authorities."

Dr. H. W. A. SANDELL (Leighton Buzzard) seconded, and the resolution was carried unanimously.

"*For how long does Vaccination confer immunity against Small-pox*," *by* Veterinary-Capt. F. SMITH, M.R.C.V.S., F.I.C., Professor in the Army Veterinary School, Aldershot.

IN bringing to the notice of the members of the medical profession certain practical points in connection with vaccination, I have had to assume what I believe to be a fact :—

1. Efficient vaccination is protective against small-pox.
2. Susceptibility to the virus of vaccina, is indicative of the person being susceptible of contracting small-pox.

The few remarks I have to make are based entirely on this second proposition ; if it be untrue or unproven then my figures and deductions are valueless, if it be accepted as proved, or in all probability true, then an examination of my figures reveals a state of affairs of considerable practical importance, and of very great interest.

As I am not a member of the medical profession, it is perhaps incumbent on me to explain the source of my information, it is derived solely from the Returns rendered to the Army Vaccine Institute, of which I have charge, by the medical officers in charge of the troops. The Institute was established to furnish a supply of calf lymph to the army, and this material is the source of nearly all the vaccinations performed at home and abroad, excepting India which supplies its own. The figures I have to quote are solely selected from the returns furnished by the United Kingdom.

It may be urged that some of the results recorded are due to the use of calf lymph, and Professor Michael Foster has drawn my attention to the necessity for clearly distinguishing between humanized and calf lymph in the length of protection afforded. Unfortunately, I have no facilities for comparing the difference, if any, in the relative protection given by these two lymphs, as humanized lymph is not issued by the Institute.

The total number of vaccinations of which I have to speak is 85,423 divided into two groups, primary and re-vaccinations :

	Primary Vaccinations.			Re-vaccinations.			Total.
	Perfect.	Modified.	Failed.	Perfect.	Modified.	Failed.	
United Kingdom ...	5,271	132	429	54,497	15,842	9,252	85,423

Percentage of successful primary vaccinations, 92·64 per cent.

Percentage of successful re-vaccinations, 88·37 per cent.

On turning to the re-vaccinations performed, to the number of 79,591, it is surprising to notice that no less than 88·37 per cent. of these men, varying, say, between 18 and 20 years of age, were found susceptible, 54,497 being returned as perfect vesicles.

I have seen many hundreds of these arms; the vesicles are as perfectly defined as in a primary vaccination. It is important to bear this fact in mind, for no matter what view we take of the modified vesicle, I think there can be no doubt that a person who developes a perfect vesicle is one who would have contracted small-pox if exposed to the contagion.

On examining the 5832 primary vaccinations it is found that 92·64 per cent. were successful; these vaccinations were only four and one quarter per cent. better than the re-vaccinations.

In what way are we to interpret these results? It is certain that of 79,591 persons only 11·63 per cent. (adopting vaccination as a test) were protected against small-pox, and this number may be further reduced when we consider that many of the failures were due to other causes than protection, for of the primary vaccinations 7·36 per cent. failed. If, therefore, we take these figures as representing the failures due to inert lymph, &c., it leaves only 4·27 per cent. of the adults as protected against small-pox by their previous vaccinations.

Cory* has shown that every person after vaccination has a tendency to return to his original unprotected condition; the further he travels back the more perfect does the vesicle become if re-vaccination be practised; the shorter distance he travels back the more imperfect is the vesicle and the more rapid its progress, for instead of having to run an eight days' course it may only have to take a three or four days' journey; the character of the eruption will, therefore, determine whether the persons required re-vaccinating badly or not.

This is doubtless true, but we are still left in ignorance of the probable length of protection afforded by efficient vaccination viz., is it a protection for a term of years, months, or weeks?

My figures show that 68·47 per cent. of persons between the ages of 18 and 20 years, have travelled back to their condition of absolute unprotection, and 19·9 per cent. have travelled back to some unknown point in Cory's scale. The first group, if exposed to infection, would have suffered from unmitigated small-pox, the latter from modified small-pox.

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* "Some Aspects of the Vaccination Question." R. Cory, M.A., M.D. St. Thomas' Hospital Report, vol. xv.

Further, are we to believe that an efficient re-vaccination at some period of our lives will give a long immunity, or an immunity which can only be measured by months? On this question I considered I had come across some new facts, but Dr. Cory in a recent letter to me, where he has obligingly stated his views on this subject, has expressed himself that he has often seen a re-vaccination take within four months after re-vaccination, the character of the eruption being, however, very modified, owing to the fact that the person had a shorter distance to travel to the safe point. Such is my experience, though I have never tried re-vaccinating within such a short time as four months after a previous re-vaccination, but I am quite clear on the point that within three years of a thorough re-vaccination it is possible for a person to be successfully re-vaccinated, the eruption produced being naturally of a modified character.

I can, however, go a step further than this, and affirm that after a successful primary vaccination, it is possible to successfully re-vaccinate a person twelve months later, the only difference between the first and second vaccinations being that the latter will run a more rapid course, though, excepting for this fact, the character of the vesicle produced is nearly indistinguishable from a primary inoculation.

The number of insertions required to give immunity is a matter of extreme importance; I have observed in re-vaccination, that an insertion made every two days will always take until five have been made. After that, immunity is obtained.

I have not had an opportunity of making this observation in a primary vaccination, but Cory mentions having vaccinated an infant every day for eleven days, and none of the insertions after the ninth day were successful.

In endeavouring to focus the facts contained in this communication I would draw attention to the following points :—

1. The large proportion of unprotected adults in the community, as judged by their susceptibility to vaccination.

2. The very brief protection afforded by vaccination and re-vaccination, as judged by the successful re-vaccinations.

3. The certainty with which re-vaccinations can be made within a short period of a previous re-vaccination.

4. The possibility of successfully re-vaccinating an infant twelve months after a primary vaccination, the vesicle running a shorter course, but being nearly indistinguishable on the fifth day from a primary vesicle on the eighth day.

5. The necessity for five insertions if efficient vaccination is to be practised.

I do not disguise from myself that we have no positive evidence that susceptibility to vaccination represents susceptibility to small-pox; in fact there is much which may be urged to the contrary, of which perhaps the German and British Armies afford the best example ; still, I consider it is a question on which we should be perfectly clear, and no harm can be done to the vaccination question by strengthening it on points which appear to present a certain element of weakness.

Mr. Washington Lyon (London) said that when the Congress met at Worcester he put a question to the Medical Officer of Health as to whether he had examined the Schools there ; he said that he had examined one School, and found that 90 per cent. of the children were vaccinated. In London with its 5,000,000 population about 7 per cent. of the children were not vaccinated. That was a most dangerous element in our midst, because such a large percentage was so likely to be the cause of the spread of small-pox.

Dr. J. F. J. Sykes (London) said it was liable to be understood from the paper that only a brief protection was afforded by vaccination, and re-vaccination, but that was not the point. The writer did not say that people vaccinated or re-vaccinated were liable to get small-pox after a few months, but that in a few months they could again be re-vaccinated. The conclusion must not be drawn that only an immunity of a few months could be afforded against small-pox, as practical results proved that the contrary was the case. For instance, the Chemnitz statistics—which were comparatively new to English readers—distinctly showed that all children under five years had absolutely escaped small-pox in that town during an epidemic, owing to vaccination. He thought Veterinary-Captain Smith might amplify this point more, so that those who were anxious to read wrongly would not have the opportunity of doing so.

Sir Thomas Crawford, K.C.B. (London), said the experience of all England and Germany, as well as the Army and Navy, was in favour of the protection afforded by vaccination and re-vaccination. All children should be re-vaccinated when they were twelve years of age, as it was generally accepted that their re-vaccination was necessary, and it should be the object of all who desire to ward off this terrible disease to be re-vaccinated.

Dr. H. W. A. Sandell (Leighton Buzzard) said he unfortunately lived in a district where vaccination had been suspended by the casting vote of the Chairman of the Board, the place having been previously whipped up by the constant agitation of a dissenting minister,

although the operation was well and carefully performed in the district. An anecdote here is worth relating; a certain anti-vaccination candidate seeking election as Guardian (?) at the time of canvassing tried to obtain a woman's influence against vaccination, and was met with the reply, "Get along with you, you can't say it does no good, for when I was a girl there was so many persons marked with small-pox, while now there are scarcely any," and as she laconically put it, "He did not trouble me further."

Mr. W. SCULLARD (Portsmouth) said there were ten in his family, and only two were attacked during an epidemic of small-pox, and it was of so mild a form that they kept about as usual, there were not more than three or four eruptions on each. He attributed this immunity to vaccination. He was pleased to see the subject brought forward, as in their town there were people defying the law and willing to go to prison rather than have their children vaccinated.

Dr. BOND said the effect of primary vaccination passed off in time. A short time ago he did duty in a hospital for small-pox in a small district. There were 100 cases in twenty-eight days. Although a strong feeling prevailed against vaccination, this was now entirely in abeyance. He got the inmates to have their families vaccinated or re-vaccinated, and he was able to persuade 450 to submit to the operation, and out of that number not a single case of small-pox occurred; but out of the 180 persons who declined there were eighty cases. It was not safe, however, to trust to primary vaccination. He had seen many cases among children who had been vaccinated, and who had had small-pox *before they reached five years.* To afford any protection, there must be re-vaccination.

Mr. WASHINGTON LYON (London) moved the following resolution:—"That this section is of opinion that the Vaccination Laws should be removed from the control of Boards of Guardians and transferred to the Sanitary Authorities, of whom the Medical Officer of Health was the Executive Officer."

Mr. W. SCULLARD (Portsmouth) seconded.

In reply, Vet.-Captain SMITH said he had hoped to learn whether insusceptibility was an indication of a person not being liable to take small-pox.

The PRESIDENT of the Section said they might accept it that re-vaccination was a necessity.

The resolution was carried unanimously.

On "Disposal of the Dead," by Rev. F. Lawrence, Hon. Sec. of Burial Reform Association.

Earth-to-earth burial is respectful, natural, in accordance with sanitary law, and consistent with economy.

I. It is respectful because no greater respect can be paid to the dead body than so to give it back to the earth as to admit of its performing its proper function in building up fresh life out of its own decay. That which above ground is offensive, under the earth is inoffensive; what is putrefaction above, becomes resolution and transformation below. Moreover, by this mode alone is it possible to preserve the sacred inviolability of the grave, for before the earth is used for another burial, the former tenant will have passed away, resolved and re-distributed.

II. It is natural, the earth being the natural recipient of everything that has lived and died upon its surface; whereas to enclose the corruptible body in a strong coffin, and to exclude from it the purifying influences of earth and air, dooms that body to seethe in its own corruption for any time to come, and to generate poisonous gases which no hermetical sealing can restrain, and which, generations hence, may find their way among the living as the avenging angels of violated nature.

III. "Earth-to-earth" burial has never been proved to be productive of evil results. The Medical Officer of the Prussian Diet in his report to the Government, Dr. Petrie before the Berlin Conference, and other eminent scientists have declared burial places, when conducted on sanitary principles, to be harmless. Mr. Seymour Haden in 1865, in his memorable letters to the *Times*, wrote: "A body properly buried, that is, in such a way that the earth may have access to it, does not remain in the earth, but returns to the atmosphere. The air with its rains filters through the earth above, and when it reaches the body, resolves it into new and harmless products." Dr. Poore, in his recent address, as President of the first Section of the Brighton Congress of The Sanitary Institute, entitled "The Living Earth," said that "the mould which forms the upper stratum of the ground on which we live to the depth of three to six feet, teems with life, and the micro-organisms which abound in this upper living mould oxidize or reduce to their atoms all

organic substances." On another occasion Dr. Poore declared properly conducted cemeteries not only harmless, but when near inhabited districts positively beneficial, as supplying the breathing places which are essential amidst great populations. Lord Playfair wrote, "If the coffin be of a perishable nature, if the soil be dry and porous, if the graves be not too crowded, the dead are resolved into air and into ashes as certainly in three years as they are in a furnace in the course of an hour, and in both cases without injury to the living." The fact is the earth-to-earth system is a quasi-cremation, effected naturally by the action of earth and air in a manner regardful of the Public Health. It is not this mode which is harmful, but the disrespectful, unnatural, irrational, falsely-so-called burial, in durable coffins and vaults.

IV. This mode is consistent with economy. This timely interment necessitated by the earth-to-earth mode of burial, that is, as soon as signs of decomposition appear, renders it difficult to procure special black attire. The simplicity of the actual burial will beget simplicity in all the accessories. The coffin will be the slightest and lightest possible, such as the coffin of compressed pulp invented by Mr. Larkman, of the Necropolis Company. There will be no massive monument on the grave, excluding air. Moreover, the cemetery being used as a quasi-crematory, that is, a place for the resolution and dispersion of the body, and not for its preservation, the entire area of the cemetery will be available for use generation by generation for all time to come, rendering a fresh cemetery unnecessary.

The enquiry at once arises,—with a mode of disposing of the dead which was respectful, natural, harmless to the living, and economical, what was it that rendered our churchyards centres of pestilence, and which now makes the disposal of the dead a question of such difficulty? It was the adoption of the use of a coffin that caused all the mischief. It was in the days of Charles I. that the old simple method was departed from. The ministers of the day disregarded the rubric, "While the body is being made ready to be laid into the earth," or, rather, they read something else into it. A coffin was buried with the body, instead of the body being laid by itself into the earth; hence the choking of the churchyards with the dead in a condition of arrested and prolonged decay; hence the poisoning of the air and the fouling of the water-springs; hence, at last, the intervention of the legislature, and the loss to the Church, for all time to come, of the use of her town churchyards—a partial disestablishment—which a disregard of a plain rubric brought upon her. But

the mischief did not stop here. To Cemetery Companies and Burial Boards was now assigned the control which from time immemorial had been vested in the Church over the ground set apart for burial, and these Companies or Boards could not at a single bound shake off the fetters imposed by evil example and rise to the heights of sanitary science. Suburban cemeteries were conducted upon the same pernicious principles as those which had rendered town churchyards a ghastly dishonouring of the dead, and a flagrant imperilling of the public health. Hence the appalling over-crowding recently disclosed in the Parliamentary returns issued at the instance of the Church of England Burial Reform Association. Nor was this all. The Cemetery Clauses Act, 1847, empowered, and still empowers, companies "to sell in perpetuity the exclusive right of burial." Subsequent statutes confirmed this power within the metropolis, thus overriding the common law doctrine applicable to churchyards, "that no right of burial can be granted in perpetuity."

What now remains to be done? I.—A perishable coffin must take the place of that now in use. II.—The Legislature can concentrate in the Local Government Board the control over cemeteries, now divided between that Board and the Home Office. The Home Office simply concerns itself in seeing that certain Orders in Council, let them be ever so inadequate, be observed. The Local Government Board has control over all local authorities, and can issue stringent regulations as shall render the burial of the dead in accordance with sanitary law. III.—The Church in her corporate capacity can exact a proper use of the churchyards that remain to her, and thus, in these latter days, set a proper example to cemetery authorities. She can compel churchyards to be regarded as for use for all time to come, and so prohibit the use of imperishable coffins and bricked graves, which constitute an unjust invasion upon the rights of generations yet unborn.

Sir Charles Cameron (Dublin) said he had been unable to convince himself of the terrible evils depicted as the result of burying the body in the ground, and he did not believe all those evils followed in any well-kept cemetery. Interments should not be allowed in crypts or vaults or near any large centre of a population, but how the ordinary graveyard in the country could be injurious to health he could not understand. If the directions of the Local Government Board were carried out—and he believed they generally were, if not

it was the fault of Local Authorities—he could not see how burials could be injurious. He did not see how the organic matter in the bodies deposited in an acre of soil could be compared to the immense quantities of organic matter placed upon market gardens. In the large gardens near London 600 or 700 tons of manure were placed on the ground, and surely that must poison the ground and air to a greater extent than cemeteries. He had made examinations of the air about the cemeteries of Dublin, and also of the water that came from drains in those places, and both he had found remarkably free from organic matter. The Local Government Board had done him the honour of quoting a statement he had made, in a letter they had sent to Burial Boards. He had said that the amount of organic matter coming from cemeteries was very small, and if cemeteries were placed outside of large towns he did not see how they could do any harm. In country districts the ordinary mode of interring the body in the ground could not be attended by any harm.

Dr. J. Ward Cousins (Southsea) supposed the last speaker was not referring to infectious disease cases, and that his remarks applied only to ordinary diseases. They had no reason to expect that such bodies did infect the soil, or that they created any great danger when buried, but in cases of infectious diseases he thought cremation was the better way to get over the difficulty. If there was sufficient evidence that such diseases were due to, and owed their origin to the specific germs or microbes, or whatever they chose to call them, belonging to the organic world, then, he thought, that the bodies of those dying from such diseases should be cremated.

Dr. Axford (Southsea) said it was to be regretted that Mr. Lawrence was not that day with them. He, Dr. Axford, felt strongly on the subject that although Mr. Lawrence had done good work in calling attention to the necessity for a better disposal of the dead, he had not gone far enough. No doubt suitable earth will reduce a body to its component elements in about twenty years, but how much better it would be that this should be done in less than as many hours. They were all willing to assist him in the crusade in which he was engaged, but Dr. Axford asked whether cremation was not valuable as an alternative process. He could not help thinking that, as ground was used up for the burial of the dead, the question would become more and more a difficult one. Quite recently there was an addition to one of the burial grounds in that borough, and the question was being discussed as to whether the old ground should not be used over again, and others were suggesting going to Portsdown Hill to bury the dead. To him it seemed a pity to take up land for this purpose when it could be so useful in other respects. If a crematorium were provided some of them thought it would be much better. That question had been discussed by the Burial Board, but there were legal difficulties in the way, and he wished these were absent. Dr. Axford considered the subject of death certificates an important one.

Most medical men were of opinion that death certificates were not what they should be. They should be of a more searching character, and they should be granted only by a Medical Officer appointed for the purpose; and more care should be exercised in the system of registering deaths. He was a very strong advocate of cremation as an alternative process for the disposal of the dead, and he would like to see every Burial Board in towns of above a certain size, compelled to provide a crematorium. The friends of the deceased would then be able to decide whether the body should be buried, or whether it should be submitted to a process by which it would be resolved into its natural elements, quickly and decently, and with no disrespect. Let only the horrible process that went on underground be considered, and there would be little or no question as to which was the best way of showing respect to the dead.

Mr. Frank R. Chappell (Portsmouth) said that among sanitarians there could be no doubt as to cremation being the best mode of disposal of the dead, but the great objection was public opinion. At present there was a strong sentiment against cremation, and he thought The Sanitary Institute could not do a much better work than to start lectures in all parts of the country to overcome this prejudice. It was only right from a scientific point of view that the sooner the body was resolved into its component elements the better. The placing of charcoal in the coffins was, by the reader of the paper, considered to destroy noxious germs. The error into which the rev. gentleman had fallen should not pass unnoticed, charcoal being simply a deodorant possessing no power to destroy disease germs.

Sir Thomas Crawford, K.C.B. (London), said that anyone who would wade through the eleven volumes of the proceedings of The Sanitary Institute would be perfectly satisfied that the subject of cremation had been thoroughly discussed by the members of the Institute at the various congresses held from time to time. The greatest authority upon cremation now living was Sir Spencer Wells, who was their President at York, and who took cremation as the subject of his address. As to the necessity of cremation as a protection against contagious diseases he would like to make some remarks. In Benares, where the dead were always cremated, and where no risk from cholera could exist from dead bodies resolving to their elements in the ground, there were constantly recurring outbreaks of cholera. So that cremation did not exempt from that disease. Then in Hyderabad, which was a Mussulman city, the system was burial, but only one body was put in a grave, of course no question as to ground available for such a purpose could arise. He was not aware of any epidemic of cholera having sprung up owing to the system of burial, either there or in any other Mussulman town. With regard to the relative expensiveness of interments or cremation, that was a question of money *versus* sentiment. People who did not wish to adopt with which they as sanitarians had nothing to do. It was a question

cremation would probably be prepared to pay for graves, although at present, cremation was quite as expensive as burial. He agreed with Sir Charles Cameron, that if the ordinary burial ground was kept in a proper state, and was not overcrowded beyond the capacity of the earth to resolve the bodies into their component elements, there should be no danger.

The PRESIDENT of the Section (Prof. Lane Notter) said it was only living earth that had the power to resolve bodies into their component elements, and some soils had absolutely no power. Dry, sandy soils were of little use to disinfect excreta. A certain percentage of moisture was essential, although this must not be excessive. This should be remembered when earth used for this purpose was artificially dried.

Dr. J. F. J. SYKES (London) said that the Rev. F. Lawrence was not opposed to cremation, but he assumed that there were timid people in the world, who were ruled by sentiment, and to these he suggested a half-way house to cremation in the manner described.

On "Infantile Mortality," by Sir CHARLES A. CAMERON, M.D.

INFANT life is carefully preserved amongst the well-to-do classes. It is rarely that the child of a rich man falls a victim to measles or whooping cough, and if it is attacked by that formidable malady, scarlet fever, its chance of successfully resisting it is very great. On the contrary amongst the poor, measles, whooping cough and scarlet fever commit sad ravages; and children who do not directly succumb to those maladies often die from secondary affections arising from them, as the result of neglect of the little patients. It is sad to think that from 15 to 22 per cent. of the children of the poor perish in the first year of their existence. Were it not for the greater fecundity of the working classes as compared with the rich sections of society, the former would not be able to keep up their relative proportion of the population. Amongst the rich, both birth and death-rates are low; they are high amongst the poor.

The high mortality of poor children is the result of a great

many causes. Defective diet is one which is most common in the first year of life. Poor and otherwise bad milk occasions a large amount of infantile disease. Who can tell how many babies are put to eternal sleep by "soothing syrups," "cordials," "carminatives," *et hoc genus omne!* These narcotics are not—with perhaps exceedingly rare exceptions—given with malign intent, but undoubtedly they are one cause of infant mortality.

Cleanliness of person, clothing and bedding, and purity of air are essential factors in maintaining children in a healthy condition—too generally they are absent from the dwellings of the poor.

The loss of infant life caused by cold and wet is enormous. Young persons are less able to resist low temperatures than adults, yet the former are less warmly clad, even amongst the upper and middle classes. Is it not cruel to allow the tender limbs of young children to be exposed to the cold blasts of winter under the mistaken idea that such exposure makes them hardy! It often lays the foundations of rheumatism and bronchitis.

I am quite convinced that the constitutions of children are weakened by the cold to which they are exposed in winter, owing to want of proper clothing and bed clothes, and of warmth in their dwellings.

It is melancholy to see in the poorer districts of towns so many wretchedly-clad children. Often a little fellow may be observed clothed in the cast-off and ragged garments of his father, sometimes not even adjusted to the child's smaller stature. It is not until boys are able to earn a little money that, as a rule, they get new and suitable clothes. It seems to me that little boys are worse clad, and are allowed to stay out in the streets to a greater extent than little girls. Perhaps this is one reason why the mortality of boys under 5 years old is about 12 per cent. greater than that of girls of the same age; whilst from 5 to 20 the mortality is only very slightly greater in males. It is only when the adult stage is reached that females exhibit for the second time their greater viability.

The following facts derived from the mortal statistics of the population of Dublin prove the appallingly high death-rate which prevails amongst the children of the working classes:—In 1891 the deaths in the families of the professional and independent classes numbered 390; of these 26, or 6·6 per cent., were of children under five years old. In the same year the deaths of persons belonging to the classes of porters, hawkers, labourers &c., and of members of their families, numbered 2,547, of which 1,077, or 42·28 per cent. were of children under five years of age.

In most towns the mortality of children has been steadily decreasing. In Dublin, for example, the yearly average death-rate of children under five years old in the period 1871-80 was 86 per 1000; in the decade ended in 1890 it was 81·7, and in 1891 it declined to 68·6. The statistics of the deaths of children in Dublin differ so much from those of the English towns, that my principal, indeed, only reason for reading this short paper is to bring them under the notice of English vital and mortal statisticians. I have tabulated these statistics as follows:—

Death-rate of Children under One Year of Age in the year 1891.

	All England and Wales.	28 largest English towns.	London.	Dublin.
To 1,000 of the population under one year of age ...	151	168	155	165
To 1,000 of the population of all ages...	4·7	5·4	4·9	4·7
To 1,000 births registered...	149	167	154	165
To 1,000 deaths registered...	231	241	229	177

This table shows that a larger proportion of children survive their first year of existence in Dublin than in the 28 largest towns of England and Wales. The rate per 1000 of the population is exactly the same as in England and Wales; but the rates of deaths of children under one year to total deaths is very much less than in the whole of England and Wales. The death-rate of Dublin, though much reduced lately, is still in excess of the English towns. In the period 1881-90 the death-rate (corrected for age and sex distribution) in Dublin was 29·6, in the English towns it was 23. With respect to the preservation of infant life Dublin stands in a slightly better position than the English towns; but the mortality amongst adults very sensibly exceeds that of the large towns of England.

Why this mortality of infants in Dublin is no greater than in English towns, whilst the adult mortality so much exceeds that in the great towns of England and Wales, is a question I do not at present propose to discuss. I may, however, state that summer in Dublin is seldom very warm, and consequently the diseases of children, which, it is well known, high temperature causes or intensifies, are less fatal in Dublin than in England.

Dr. H. W. A. Sandell (Leighton Buzzard) said that one of the causes in manufacturing districts was the custom of young mothers giving their infants to elderly females to take charge of, while they went to work at the mills, and these women often gave the children opiate cordials to keep them quiet. Then, too, in such cases the children were frequently given unsuitable and unsound nourishment, allowed to run riot, and not taken proper care of in illness.

Dr. J. F. J. Sykes (London) criticised the statistics, and thought the comparison between the deaths under one year with the one thousand deaths at all ages was scarcely reliable, as both factors were variable.

Dr. D. B. Kendell (Wakefield) said that in dealing with death statistics, an important point was generally lost sight of. It should be necessary when returns were sent from large towns to give some clue as to the relative proportions of rich or poor, because the disadvantages under which poor people lived must have a marked effect on their mortality returns, and the mortality amongst their children must also be greater. Therefore, in speaking of the death-rate of one town being higher than that of another, there ought to be some figures showing the relative proportions of the better class and of the poor, before any idea could be formed as to sanitary conditions.

Dr. Tayler said that living as he did in a manufacturing district the subject was of interest to him. They had the large ratio of 58 per cent. of deaths among children under five years of age, and the most part were children of the operatives. At one time this was put down to the system of clubs in which the children were entered, and it was thought that parents were wicked enough to want to get rid of the children for the sake of the money they would receive from the club, but on enquiries being made it was found that this was not so. The entering in the clubs was simply a matter of precaution by parents, as the rate of mortality being high, they were afraid that their children might die and they would have no money to bury them with. The cause was found to be the mothers leaving their young babies to the care of other people, often when only three weeks old, while they went out to work. Improper feeding was also a fruitful cause of the high mortality.

Mr. W. Scullard (Portsmouth) mentioned a case that came before the Portsmouth Magistrates, in which four children had died, and the fifth was nearly starved. All were insured, and this he thought was one reason for the high rate of mortality.

Sir Thomas Crawford, K.C.B. (London), thought a large amount of infant mortality was due to artificial feeding. If they walked about the streets of London, they could not but notice the large proportion of children sucking milk of doubtful purity from feeding bottles. It was also largely due to mothers working in factories, and to insanitary surroundings, and cruel neglect including over-laying.

Mr. J. Oldfield (London) was disappointed at Sir Charles Cameron not suggesting a remedy. It was one of the most serious things of the day, and he suggested that one cause was bad milk, and another the giving of children of immature age starchy food. At so early an age they could not digest this kind of food, and yet a large proportion of artificial food was starchy. It was a question for Medical Officers to consider what was the natural food for infants, and then to distribute information on the subject, especially pointing out the danger of giving starchy food.

Dr. Trevor Fowler (Epping) said he was Medical Officer of Health for a district near London. The rate of mortality among children was not high, compared with the mortality in other districts. The great difficulty was to obtain new milk. Time after time he had advised mothers to feed their children on milk, but he was informed that they could not obtain it, as all the milk was sent up to London. It was practically impossible to get it, and the same complaint came from other rural districts near large towns. Milk could not be obtained at any price, and unless some measure was devised to get it in the rural districts, the rate of mortality would be even yet higher than it should be.

Dr. J. Groves (Carisbroke) said that taken generally children were less fed with milk in country districts than in towns, owing to the impossibility of the labouring class getting milk in the country. The vendors of artificial foods were alive to this, and they devoted most of their attention to country districts. That was not only his experience, but also that of other Medical Officers of Health in various parts of England. He had encouraged agricultural labourers with large families to club together to keep a cow or two.

Sir Charles Cameron (Dublin) in reply said his sole object was to bring forward some curious statistics with regard to Dublin, If he had gone into the whole question of infantile mortality it would have taken a much longer time. The high death-rate of infants was most deplorable, and he attributed it largely to their artificial feeding. It was, however, often found very much better for children to be fed upon good milk rather than upon the poor milk furnished by mothers living amidst the artificial surroundings of a fashionable life. In the United States very few ladies nursed their own children. The want of cleanliness among the poor was also an important consideration, because often, owing to this, milk turned sour. He agreed as to the starch foods being improper, as children were unable to secrete in their mouths the necessary digestive ferments, and the giving of such food was a cause of disease.

On "*The Physical Condition of Children*," *by* Francis Warner, M.D.Lond., F.R.C.P.

Hygiene is a progressive science, or group of sciences : for its advancement we require knowledge of all conditions affecting the constitution of man, and of the circumstances increasing or depressing public health. State medicine is employed not only to prevent disease and death, but also to favour the evolution of a healthy, well-developed and long-lived population. In presenting a sketch of an enquiry as to the physical condition of 50,000 children seen since 1888, I must first explain the objects aimed at and the methods pursued. The desire of the Committee (a joint Committee of the British Medical Association and the Charity Organization Society) who undertook this work was to make observations and report upon the development and physical conditions of body and brain of school children, to which the report of the teachers as to mental capacity was appended in each of the 9,186 cases of which notes were taken. The points noticed were deviations from the normal conditions below the average; thus the field of observation differed from that of the hospital and asylum in dealing with the school population as a whole; our plan differed from that of the Anthropologists, who seek to determine an average of the class observed, inasmuch as we passed over all children of the normal, or above it, while noting and classifying abnormalities.

As to development of the body (physiognomy, proportions, &c.), the points observed were those well known as common among idiots, imbeciles, and described in many cases as characteristic of the criminal type, viz., defects of cranium, palate, ears, epicanthis, &c. The degree of these defects seen among school children is much lower than among idiots; thus: among the 50,000 cases small heads were found in 1,050 cases, but I think there were only two microcephalic idiots; there were 1,321 cases of defect of form in the palate, but many were only slightly arched or narrow.

When inspecting a school the children are seen usually a standard at a time as they stand in rank, the signs determined on can be observed in each child, and for every case where some deviation from the normal is observed, a schedule form is filled up describing particulars. The work is thus done methodically and easily, without questions being asked of the children. To keep my paper within moderate limits I must pass over the

signs observed as indicative of the nerve-condition,* but the term "Nerve-case" is used as applied to a child presenting any visible deviation from normal nerve-action. The term "Low nutrition," is applied to a child pale, thin, delicate, or with indications of low physical health.

As to the "development cases," are they placed at a disadvantage by their condition? The report shows that 52 per cent. had disordered nerve-conditions, 25 per cent. low nutrition, 40 per cent. were dull. If development defects could be prevented it seems that we should have better average brains, improved strength, and the educational problems would be simplified. The defects are less common among girls than boys, but the power of resistance to adverse circumstances is less strong among girls with low development than with boys. The percentage correlation is given in Table I. (p. 134), and is applied to individual defects. Of 2,003 cases of low nutrition, 1,233 were "development cases" among the 50,000. It appears that for improvement of the population we could not work more effectually than by an endeavour to determine the causes leading to these defects, and attempting to remove them. Some facts in the report are interesting in the direction of Etiology. Among the nationalities there are great differences in the percentage of "development cases," for Jews, 7·5; English, 10·8; Irish, 20·0; details are given in Table II. (p. 135). The percentage of these cases varied in the schools of different districts; Islington, 7·4; Kensington and Chelsea, 12·5. 35,000 children were classified in the day schools of 20 districts, but it is obvious that a much extended enquiry is necessary before the relative condition of the children in the districts can be accurately determined. In schools of upper social class 10,000 children were seen in contrast with 25,000 in day schools of poorer class, and the percentage was to the advantage of the latter. The "small-headed children" form an important group 1,065 (boys 327, girls 738). The condition is found to be twice as common among girls as boys; this suggests searching for a special cause. Among the 50,000 children the percentage of small heads is:—Boys, 1·2; girls, 3·2; both sexes, 2·1. But the distribution in areas is very unequal.

				Percentage of Small Heads. Boys.	Girls.
Bermondsey,	Boys 1,135,	Girls 773	...	0·1	2·8
Strand,	,, 484	,, 452	...	1·4	7·0
City of London,	,, 321	,, 590	...	1·2	6·1
Bethnal Green,	,, 718	,, 632	...	1·1	·4

* All these signs were described in the Milroy Lectures, Royal College of Physicians, 1892, and in the Author's work, "Mental Faculty," Cambridge University Press.

The children in the Strand schools live, as I was informed, exclusively in large block buildings, and the City schools are surrounded by similar structures. Bethnal Green, on the other hand, is mostly small property. It seems possible that in the case of these small-headed girls we have an example of degeneration due to want of light and air, owing to the character of the buildings.

Inspection of children supplies evidence that appears worthy of attention as affording a basis for the solution of many important social problems. Biologists have led us to look so strongly to the effects of heredity, and the non-survival of weak members in a species, that in social science we have been too apt to lament the want of power to control heredity and remove the defective; perhaps, rather to the neglect of observation of the controllable variations of environment in their effects on the development of the population. What are the effects of elevated sites, drainage, water supply, high buildings, narrow streets, adjacent railways, open spaces, &c.? An answer may be sought by observations of children living under varied circumstances, and by analysis and comparison of the results.

I am not prepared to assert that "development cases," with their attendant evils, are degenerations from the normal of modern occurrence, or even that they are degenerations at all; a high percentage of such children in a community may indicate a condition of the people as yet unevolved with latent capacity for higher evolution of a normal, under wise guidance a better and more uniformly good type may spring up, leading to increased average brain power, more capacity for resistance to adverse conditions, and increased longevity.

Inspection of children has already afforded much useful knowledge, the accumulation of which, year by year, would in time show the conditions of evolution or degeneracy which may be going on among us; at the same time such studies would probably afford evidence as to causation of changes occurring, and the means of prevention and cure for many existing evils.

Details of the signs observed, and their significance, have been published; a full report on the results of this enquiry has been prepared and presented to the Local Government Board, and a Committee is now actively engaged in furthering this enquiry, so that in a year or two we may have a basis of facts accumulated showing new directions in which Hygiene may advance the general well-being of the people.

TABLE I.—*Showing Number of Children with each Defect in Development, also giving their Correlations. Percentages are taken on number of cases presenting the defect.*

	Total of cases presenting each defect among 50,000 children.			With abnormal nerve signs.				With low nutrition.				Reported dull by Teachers.			
				Number of cases.		Percentage of cases.		Number of cases.		Percentage of cases.		Number of cases.		Percentage of cases.	
	Boys.	Girls.	Total.	Boys.	Girls.	Boys.	Girls.	Boys.	Girls.	Boys.	Girls.	Boys.	Girls.	Boys.	Girls.
Total of "Development cases" ...	3,616	2.235	5,851	1,975	1,096	54·6	49·0	732	726	20·2	32·0	1,398	928	38·3	38·7
Cranial abnormalities	1,528	1,048	2,576	850	531	55·6	50·6	392	480	25·7	45·8	634	477	41·4	45·5
Defects of palate	796	525	1,321	441	262	55·4	48·9	173	155	21·7	28·9	324	232	40·7	43·3
Defects of external ear	1,047	268	1,315	566	128	54·0	47·7	196	72	18·7	26·8	340	103	32·4	38·4
Epicanthis	514	384	898	227	160	44·1	41·6	65	73	12·6	19·0	192	136	37·3	35·1
Children small for age..............	209	209	418	119	110	56·9	52·6	88	101	42·1	48·3	78	79	37·3	37·3
Nasal bones deformed	241	214	455	131	95	54·3	44·3	16	19	6·6	8·8	87	77	36·1	36·0
Features large or coarse	147	104	251	112	68	76·1	65·3	19	17	12·9	16·3	73	43	49·6	41·3
Palpebral fissures small	98	83	181	61	57	62·2	68·6	22	16	22·4	19·2	41	39	41·8	47·0
Mouth small	27	17	44	16	10	59·2	58·8	8	2	29·6	11·7	8	10	29·6	58·8

TABLE II.—*Groups of Schools, giving the Number of Children seen, and Percentage of Conditions taken upon the Number of Children seen.*

	Boarding Institutions.		Day Schools.		English Day Schools.		All Irish Schools.		Jew Day Schools.		Day Schools of Upper Social Class.		Poorer Day Schools.	
	Boys.	Girls.	Boys.	Girls.	Boys.	Girls.	Boys.	Girls.	Boys.	Girls.	Boys.	Girls.	Boys.	Girls.
No. of Children seen	8,246	5,403	18,638	17,740	16,932	15,875	1,694	594	1,389	1,572	5,281	4,934	13,357	12,806
Percentage noted	24·1	17·7	19·1	14·9	19·2	14·9	35·5	19·3	17·7	13·8	21·2	16·1	18·3	14·4
Percentage of— Development cases	16·0	12·4	12·2	8·8	12·5	9·0	22·4	12·9	8·3	6·8	14·3	8·5	11·4	8·9
Nerve cases	16·1	10·3	11·1	8·6	10·9	8·5	25·6	11·9	11·1	8·3	12·7	10·5	10·5	7·7
Low nutrition	3·5	2·8	3·9	4·6	3·9	4·7	4·9	5·8	3·0	2·4	4·8	5·6	3·6	4·2
Reported dull	9·7	8·1	7·5	5·7	7·8	5·7	14·3	9·7	4·6	5·6	8·7	5·8	7·1	5·7
Eye cases	3·4	2·9	2·9	2·6	2·3	2·6	4·8	4·5	3·3	2·7	3·1	2·9	2·8	2·5
Cranial abnormality	......	......	......	......	4·5	3·8	11·2	5·2	3·3	3·2				
Palate defective	......	......	......	......	2·7	2·0	4·7	4·7	1·1	1·2				
External ears defective	......	......	......	......	3·6	0·9	6·9	1·1	3·0	1·4				
Epicanthis	......	......	......	......	1·8	1·5	2·1	1·3	0·3	0·7				
Other defects in development	......	......	......	......	2·6	2·3	7·7	5·8	2·3	1·9				

Mr. J. Oldfield (London) said that with regard to the higher percentage of small heads among girls than boys, mere consideration of the present would not account for it. But going back to the early times of the origin of man and woman, they found that woman depended upon man for her very existence. Man was the dominant animal, and so woman got to look up to him as being necessary for her existence. Man, being the stronger, was her leader. It was only in recent years that the equality of the sexes was recognised. But even now, if there was only a crust in the house the woman would take nothing and give it to her husband. This was a relic of the chivalry of woman. She looked up to her husband, made sacrifices for him. The same rule applied in every act of her life. If there was a dark room in the house, it was given to the girls and not the boys. It was the boys who were put to the public schools, and the girls had to give way. This relationship applied in all the laws of nature. It appeared as if the male was more important than the female. If there was not enough nutriment for both, both must die or one must be sacrificed for the sake of the other. It was more necessary apparently that the male plant should survive, and among animals there was a greater robustness usually found among males than among females. But although the girl might be inferior to the boy physically, yet ethically, by her very self-sacrifice for the sake of the boy, she proved herself his superior.

The Route of Asiatic Cholera in 1892, by Dawson Williams, M.D.

In the short paper which I have ventured to undertake to read on the subject of Cholera, I shall confine my remarks to certain points as to the mode of spread of the present epidemic. The literature of Cholera is enormous in amount, and most heterogeneous in character; it ranges from the portly folios issued by the Indian Government to the telegrams in yesterday's newspaper, the one elaborate and authoritative, but published a year or longer after the event, the other prompt indeed, but either founded on popular rumour or on official statistics which are not always entirely trustworthy. Municipal, and sometimes it is possible even state authorities appear to consider that they are serving their own interests by concealing facts as to the existence and progress of epidemic disease; such concealment is seldom successful for more than a very limited period, and in its ultimate effects on the commerce

of the country and the public health of other nations it is as disastrous as the attempt is disingenuous.

Even so much information as is made public abroad is only to be obtained in England through non-official channels. The Government of this country, though from several points of view more interested than any other, and possessing unrivalled opportunities, has no machinery by which it can gather and compare facts as to the progress of epidemics abroad. British ships may sail for infected ports, and, as was recently the case at Santos during the epidemic of yellow fever there, the mortality among the crews on arrival may be so great that the vessels are unable to return, yet it is only after the facts have become matter of public notoriety and scandal that a Government Department issues a tardy notice warning shipowners of the danger.

The *Comité Consultatif d'Hygiène* of France has earlier and better information as to the movements of Asiatic Cholera than can be gathered in this country, and the United States has, from time to time, obtained special reports from its Consuls on the existence and progress of epidemic diseases. There is not in this country any public office or department whose duty it is to deal with questions of public health as they affect the relations of the United Kingdom with its colonies and dependencies, and with foreign countries. The Local Government Board is concerned only with internal administration in England, and neither the Foreign Office nor the Board of Trade has been provided with the necessary medical advisers. It appears to be highly desirable that our Consuls abroad should be instructed to report promptly the presence of such epidemic diseases as cholera, yellow fever, small-pox and plague; such reports, after being epitomised by an officer appointed for the purpose, should be placed at the disposal of the public, either by means of notifications in the Gazette, or by being communicated directly to the public press, in the same way as the daily notices of the Meteorological Office are now issued.

In tracing the progress of the present epidemic of Cholera it does not appear to me to be necessary to include a consideration of the occurrence of the disease last year in Syria, or its recrudescence there this summer. There is no evidence of any spread from Syria either northward or westward; on the contrary, all the evidence goes to prove that Asiatic Cholera reached European Russia this year by a track differing altogether from those followed during the last half century, though nearly approaching the route taken by the earliest epidemics which reached this country. Speaking broadly, Asiatic Cholera has followed three main routes from India to Western Europe.

(1) It has passed through the North-west Provinces of India into Afghanistan, and thence along the caravan routes by way of Balkh, Bokhara, and Khiva to Orenberg in Russia, (1829, 1843-4); (2) it has spread from Southern India up the Gulf to Persia, and radiated south-westward to Syria and Egypt, and north-westward across Persia to the Caspian Sea, thence to Astrakhan on its western shore, and from that port up the Volga to Saratov and Kasan (1830); (3) it has been transported, mainly in relation with the pilgrim traffic, to Red Sea ports, has gained Egypt, and spread thence to the Mediterranean basin. Since 1865 the epidemic has always, until this year, taken the last mentioned route, and the attention of international conferences has been, in the main, confined to devising precautions for protecting Europe from invasion by way of the Red Sea and Egypt.

This year the epidemic has once more followed a northern course, and has afforded one more striking illustration of the readiness with which Asiatic Cholera can be conveyed along lines of human intercourse.

Cholera appeared in Afghanistan late last year, and caused a considerable mortality in Cabul; during the winter months (January and February) the epidemic died down, but in March, 1892, there was a severe outburst, and the disease continued to be epidemic for several months. In March also the disease had reached Herat, in North-western Afghanistan, and was producing several hundred deaths a day. Two months later it had become established in Meshed in North-eastern Persia, and spread slowly thence to Mishapur, Sabzawar, Abbasabad, and Shahrud, only reaching Teheran some two or three months after its appearance in Meshed.

Very different from this slow march of the epidemic westward through Persia from Meshed, was it swift progress once it touched Russian territory. The disease was recognised at Askabad during the first days of June, having in all probability spread there from Meshed a little earlier. At Askabad the epidemic reached the Transcaspian Railway, which runs from the eastern shore of the Caspian Sea, through Askabad and Merv, to Bokhara and Samarcand.* Cholera spread eastward and west-

* Since this paper was written, some statistics of the Transcaspian Railway have been published by the *Journal of the Ministry of Finance* in Russia (*Times*, Nov. 22nd, 1892). The length of this line is nearly 900 miles. The number of passengers in 1891 was 202,408, exclusive of about 40,000 soldiers. Further evidence of the growth of traffic is afforded by the fact that the export of Russian goods has more than doubled since the line was completed in 1889. Large quantities of Indian tea are imported into Russia by this route.

ward along the course of the railway with great rapidity. Nor was its progress arrested, or even checked by the Caspian Sea, for its presence in Baku on the western shore was admitted officially within a fortnight of its recognition in Askabad, and private telegrams show that it had undoubtedly been present for a week or ten days before this. Baku is an important trade-centre. It is the terminus of the Transcaucasian Railway which brings it into direct communication with Black Sea ports, while steamboats on the Caspian connect it with the terminus of the Transcaspian Railway, and with Astrakhan, the southern outlet of the trade of the Volga. The spread of the epidemic in Baku itself, favoured by the existence of gross sanitary defects, and by the want of competent municipal government, was rapid, and even the brief telegraphic despatches have given a picture of social disorganisation which can hardly be equalled in the whole terrible gallery which Asiatic Cholera has provided for the punishment and instruction of mankind.

With Cholera raging in Baku, and with an inept administration relying entirely upon quarantine regulations illogically planned and imperfectly carried out, it was no matter of surprise to find that the epidemic found its way eastward along the Transcaucasian Railway as far as Tiflis, and northward by the Caspian boats to Astrakhan. How early the last named city was infected is not, and probably never will be, known; when the presence of the epidemic in Astrakhan was recognised officially, it was already prevailing in Saratov, some 500 miles higher up the river, and a week later was reported from Kostroma, to the north-east of Moscow.

Within a month, therefore, of the recognition of Cholera at a town on the Transcaspian Railway it had penetrated to the heart of Russia in Europe, the transit from Central Asia having taken as many days as, before the creation of railways and steamboat lines, it took months. The recognition of the significance of this fact is, perhaps, the most important lesson which the present epidemic has as yet afforded.

Having traced the progress of the epidemic from Afghanistan to Persia with great probability, and from Persia to Russia in Asia, and from Russia in Asia to Russia in Europe with precision, it remains to enquire how the infection reached Afghanistan. As to this there is room for some difference of opinion. It is natural in the first instance to turn our thoughts to the Hurdwar Fair, the continuance of which the Government of India found it advisable this year to prohibit on account of the danger of the dissemination of Cholera. This great assembly of people, brought together primarily by a religious object, is frequented by pilgrims and traders from the

north-western provinces, by Kashmirees and Border men. The prohibition was not completely effective, and many of those who reached Hurdwar at an early date, or eluded the vigilance of the officials at a later, undoubtedly carried Cholera for considerable distances. There is strong reason to believe, though the fact cannot be positively affirmed, that the disease was thus conveyed to Srinagar, the capital of Kashmir, where a severe outbreak occurred in May. While it will be admitted that the accumulation of a huge multitude of people at Hurdwar in the early spring, and their dispersal in every direction throughout North-western India and the frontier countries is a fact, the significance of which for Europe is greatly increased by the proof now afforded that Cholera may be carried in a few weeks from the confines of Afghanistan to European Russia, it appears that the Hurdwar fair is not in any way responsible for the movement of Cholera this year.

As has already been said cholera was epidemic in Afghanistan at the end of 1891. A month or two earlier—in September—an outbreak had occurred amongst labourers in the Hoti Mardan district of the Peshawar division; there appears to be little doubt that this outbreak was originated by men coming from Swat, and other independent territories to the north-east of Peshawar. The labourers immediately dispersed, many fleeing to Peshawar, where an epidemic of a peculiarly fatal character occurred both in the town and in the Pathan villages in the immediate neighbourhood. The mortality in some of the villages in the valleys towards the eastern mouth of the Khyber Pass was particularly severe. At a later date many villages in the Shinwari country lying to the north of the western end of the pass were ravaged, and towards the end of the year Cabul itself was attacked, as already said.

It does not seem to be necessary to refer at any length to the spread of the epidemic to Hamburg; its dependence upon the line of emigration from Russia appears to be probable, and the likelihood of the occurrence of cases among emigrants arriving at that port from infected districts *en route* for England and America ought to have been foreseen, and provided for, by the authorities in Hamburg. This does not seem to have been the case, and insanitary conditions appear to have been allowed to prevail, of which we now see the inevitable consequences. Neither does it come within the scope of the present paper to discuss the nature of the choleraic disease which prevailed in Paris this summer.

In conclusion, I would venture to make the following observations :—

(1) The greater rapidity of transit has increased the pro-

bability of the importation of Cholera and other epidemic diseases from Central Asian countries to European Russia, and thence to Europe in general.

(2) Asiatic Cholera, in travelling by land routes, depends for its power of continued progress mainly upon the existence of insanitary conditions in towns in which traffic is temporarily arrested for transhipment or otherwise. The necessary delay affords time for persons from infected districts to be attacked by the disease, and so to infect the place at which the halt is made. Such places become fresh centres from which the disease spreads along lines of traffic. This fact is well illustrated by the history of the present epidemic in Baku and in Hamburg.

(3) Quarantine has once more shown itself to be a most ineffectual method of checking the spread of Cholera. Quarantine, for instance, between Baku and Astrakhan utterly failed to prevent the spread of the infection to the latter town.

(4) On the other hand, medical inspection of travellers, especially of those of the poorer emigrant class, combined with isolation of doubtful cases, appears to be once more showing itself to be an effectual method. At the same time it must be recognised that no method can be effectual in the absence of good sanitary conditions in ports and other centres of transhipment or temporary arrest of traffic. In fact it may almost be said that the only effectual method of excluding Cholera is to ensure that its infectious principle, in common with that of other diseases of similar nature, shall be excluded from water-supplies.

(5) The need for more precise, earlier, and more authoritative information as to the existence of epidemic diseases in all civilised countries is urgent, and, pending the organisation of an international understanding upon the subject, it appears to be desirable to urge upon the Government of this country the creation of an Epidemic Intelligence Department in connection with the Local Government Board. This Department should collect and collate the information in the possession of that Board, of the Board of Trade, and of the Foreign Office.

(6) The presence of Asiatic Cholera this summer and autumn on the Transcaucasian Railway should not be lost sight of, as a recrudescence may occur next spring, and lead to infection of Batoum and Poti, and thence of other Black Sea ports.

On "The Sanitary Influences of Harbours and Exposed Foreshores," by J. WRIGHT MASON, M.B., C.M.. D.P.H., Medical Officer of Health, Town and Port of Hull.

THE subject which I have been entrusted by the Council to bring under the consideration of this Congress, viz., "The Sanitary Influence of Harbours and Exposed Foreshores," is now receiving the attention not only of the Local Government Board, but of all Authorities exposed to the danger of a possible invasion of cholera into this country.

Our security against the possible invasion of cholera depends upon the preparedness or otherwise of our first line of defence, and it should be the duty of every Port Sanitary Authority to seek out and remedy any defects in their sanitary administration. The unreadiness to act in emergency leads to a want of confidence and consequent panic, producing a depressing influence upon the mental and moral force of a population.

The epidemic of cholera which now threatens the whole of Europe, first appeared, according to a high authority, in the provinces of North-Western India, during the months of March and April, amongst the pilgrims visiting the Hurdwar Fair, near the source of the Ganges. From thence the disease spread through Cashmere and Afghanistan, reached Persia during the months of May and June, spread through the population of Asiatic Russia, from whence it has made rapid progress through European Russia, and since April has extended in a north-westerly direction.

According to Cornish the history of cholera is very apt to repeat itself, and therefore we may reasonably presume that the same circumstances which happened in 1831 are very likely to repeat themselves in 1892, and succeeding years; the route taken by the present epidemic being almost identical with that which pervaded Europe in 1831.

During the visitation of cholera in 1832, England became invaded by means of the sea route from the Baltic, and in 1849 the visitation travelled in much the same direction.

In 1853 the disease took a similar course, Norway, Sweden, Denmark, and the Baltic Ports being attacked before reaching this country.

The line of human inter-communication between the East and Europe, in 1865 and 1866, had undergone a change. The Cape route had given way to that across Egypt and the

Mediterranean, and cholera in those years first attacked Southern Ports.

The construction of the Suez Canal opened up a direct route between our Indian possessions and Europe; and the disease in 1884 and 1887, was conveyed by a French transport from Tonquin to one of the Mediterranean ports of France.

More recently the line of railway laid down by Russia has superseded the old desert course, and it is by this new railway route, through Turkestan, that cholera has this year reached Europe.

Directly the Asiatic ports of the Caspian were attacked, the disease soon traversed Baku and Astrakan, attacking towns south of the Caucasus, and hence the danger of the invasion of cholera to our Eastern ports of the Baltic.

Cholera follows the line of international communication, and with modern increased facilities for rapidity of transit, so is the danger of its possible invasion increased by emigration or otherwise. The experience of previous epidemics has shewn that the progress of cholera is greatly influenced by seasons and atmospheric conditions, and after lasting for a period of about three years, the epidemic force seems to have expended itself.

As a result of the Sanitary survey made in anticipation of cholera in 1885 and 1886 by Drs. Ballard and Blaxall, on behalf of the Local Government Board, much has been done to perfect the first line of defence, by the consolidation of joint authorities for purposes of administration, medical inspection (either for the purpose of investigation as to the causation of disease, the removal of sick persons to hospital, or the remedying of sanitary defects), and the institution of hospitals (either by themselves or in conjunction with others), and disinfecting stations.

Quarantine has now been practically abolished. The Quarantine Act of 1825 still exists, but is never enforced, except in cases of yellow fever. Quarantine stations which once abounded around our coast have now disappeared, and I believe Liverpool is the only port which still retains a Quarantine officer, appointed by the Customs authority to carry out the Act in cases of yellow fever and plague, and by a general order of that body, he is instructed to inspect all ships arriving with infectious disease on board (except cholera) and should the disease be plague or yellow fever, he is to place them in quarantine.

In the case of other infectious diseases, the Customs Officer is directed to communicate the fact to the Medical Officer of Health, who then takes charge of the patients and ship.

Under the Cholera Regulations (general) issued by the Local Government Board, 1890, the Sanitary Authority, on notice being given to them by an officer of Customs, shall cause the

ship in regard to which such notice has been given to be visited and examined by the Medical Officer of Health, to ascertain whether she is infected with cholera; or the Medical Officer of Health, if he has any reason to believe that such ship coming or being within the jurisdiction or district of the Sanitary Authority, whether examined by the officers of Her Majesty's Customs or not, is infected with cholera, shall, or if she has come from a place infected with cholera, may, visit and examine such ship, for the purpose of ascertaining whether she is so infected, and the master of such ship shall permit the same to be visited and so examined.

If, on examination, he shall declare the ship to be infected with cholera he shall give a certificate (in duplicate) to the master and retain a copy to be transmitted to the Sanitary authority.

The master of the ship so certified shall then moor or anchor the ship at the place fixed for that purpose, and shall remain there until the requirements have been fulfilled. No person shall be allowed to leave the ship, and the medical officer shall next proceed to examine every person on board the same, and any person suffering from cholera or any illness which the medical officer may suspect to be cholera he shall certify accordingly. Any person not so certified shall be permitted to land immediately on giving to the medical officer of health his name and place of destination, stating, where practicable, his address at such place. The names and addresses of such persons shall be given by the Medical Officer of Health to the clerk of the Sanitary authority, and he shall thereupon transmit the same to the local authority of the district in which the place of destination of such person is situate.

The person certified to be suffering from cholera shall be removed, if his condition admit of it, to some hospital or suitable place, and he shall not leave such hospital or place until the Medical Officer has certified that such person is free from disease, or if the person cannot be removed, he shall remain on board the ship and shall not be removed from, or leave, without the consent in writing of the Medical Officer of Health. Any person certified by the Medical Officer of Health to be suffering from any illness, which such officer suspects may prove to be cholera, may either be detained on board the ship for any period not exceeding two days, or be taken to some hospital or other suitable place appointed for that purpose, and detained there for a like period, in order that it may be ascertained whether the illness is or is not cholera.

The Medical Officer of Health shall give such directions, and take such steps as may appear to him to be necessary to prevent

the spread of the infection. In the event of any death taking place whilst the ship is detained, the master shall, as directed by the Sanitary authority, or Medical Officer of Health, either cause the dead body to be taken out to sea, and committed to the deep, properly loaded to prevent it rising, or shall deliver it into the charge of the said authority for interment, and the authority shall, thereupon, have the same interred.

Lastly, the master shall cause any articles soiled with cholera discharges to be destroyed, and clothing, bedding, and other articles of personal use likely to retain infection, which have been used by any person who may have suffered from cholera on board such ship, or who having left the ship, shall have suffered from cholera during the stay of such ship in any port, to be disinfected, or (if necessary) destroyed, and if the master shall have neglected to do so before the ship arrives in port, he shall forthwith, upon the direction of the Sanitary authority, or the Medical Officer of Health, cause the same to be disinfected and destroyed, as the case may require, and if the said master neglect to comply with such direction within a reasonable time, the authority shall cause the same to be carried into execution. The master shall cause the ship to be disinfected, and every article therein, other than those last described, which may probably be infected with cholera, to be disinfected or destroyed, according to the directions of the Medical Officer of Health.

With the development of cholera and its possible spread through the importation, firstly, of rags from France; secondly, of rags, bedding, or disused or filthy clothing, whether belonging to emigrants or otherwise, from any foreign port in Europe north of Dunkirk; and thirdly, from any port in the Black Sea or Sea of Azov, whether Russia, Roumania, Bulgaria, or Turkey, or from any other port in Turkey in Asia, regulations have been issued by the Local Government Board, that no rags, &c., shall be delivered overside except for the purpose of export, nor landed in any port or place in England or Wales. Further, if any such rags, bedding, or clothing shall be delivered overside or landed in contravention of this Order, they shall, unless as forthwith exported, be destroyed by the person having control over the same, with such precautions as may be directed by the Medical Officers of Health of the Sanitary Authority within whose jurisdiction or district the same may be found.

Recent important additional precautions have been issued by the Local Government Board, amending the General Regulations of 1890.

Article 12 of that Order is so amended, that a person shall

not be permitted to land unless he satisfy the Medical Officer of Health as to his name, place of destination, and address at such place.

Secondly, by an order dated 31st August, 1892, if the medical officer of health have reason to believe that any ship coming or being within the jurisdiction of the Sanitary authority is infected with cholera, or has come from a place infected with cholera, he may direct the bilge water to be pumped out before such ship enters any dock or basin; and on the Sanitary authority providing a proper supply of water for drinking and cooking purposes for persons on board the ship, he may direct all casks or tanks on board the ship containing water for the use of such persons to be emptied, and the master shall cause the said directions to be carried into effect. I have long since caused this precaution to be carried out, and instructions have been given to masters of all ships that they should not take in drinking water at an infected port, unless the quality of the water admitted of no suspicion, and that all bilge water should be pumped out before entering the dock, and this (during the present epidemic), I took an early opportunity of representing to the Local Government Board.

The frequent and short communication of the northern ports (more particularly Hull and Grimsby) with German and Baltic Ports (averaging from 30 to 36 hours), and the number of Russian emigrants arriving *en route* for America, *via* Liverpool, has exposed these respective ports to considerable risks and danger of the importation of cholera. Ships may arrive with crew, passengers, and emigrants all well on board, yet cholera may possibly become developed amongst the crew whilst remaining in the port, or amongst the emigrants during their transit to Liverpool, or when remaining there previous to their final departure for America. The port has, therefore, to depend upon not only its first, but also its second line of defence, and it is necessary to use every precaution by disinfection of the temporary lodging accommodation provided for their reception, pending their departure.

I have dealt somewhat at length with cholera, but why should not the same regulations apply to ships affected with yellow fever, and I would suggest that it should be compulsory for all vessels with infectious diseases on board to be detained, awaiting medical inspection.

The present regulations do not admit of vessels being detained having cases of small-pox, diphtheria, scarlet fever, and measles on board.

A hospital fully equipped with a disinfecting station and ambulance is a necessity, either a floating hospital for conveni-

ence and administrative purposes, or so situate as to be in immediate contiguity to the Docks, provided, if possible, with a landing stage, in order that patients may be admitted with the least possible publicity and exposure. The hospital should be provided with a distinct system of drainage otherwise than that connected with the town's sewage system.

Wards should be appropriated not only for the treatment of special diseases, but distinct wards set apart for the treatment of doubtful cases. The usefulness of such hospitals is often defeated by charges being made for admission, and it would be well, since such hospitals are erected for the maintenance of the public health, that they should be free for the reception and isolation of infectious cases.

A well-organised staff of trained and skilled inspectors is all-important.

Our ports being in direct communication with all parts of the world, renders it necessary that the second line of defence against the possible introduction of cholera or other diseases should be well protected, and the early preparations against the means by which such diseases, if imported, naturally spread, should be calmly studied, thought out and perfected in the interim.

Special attention should be directed towards a pure and unpolluted water supply, the periodical and regular removal of all excreta and refuse matters in the midst of populations, the frequent flushing of all drains and sewers, the prevention of overcrowding, the systematic inspection of common lodging-houses, lastly but not least, our food supplies. These are necessary adjuncts in the sanitary administration of the gateways to our country, and our foreshores should not be exposed to the nuisance and dangers of the deposition of towns' sewage along the banks of our tidal rivers. The dangers to which they are naturally exposed, from a public health point of view, is compensated by their geographical position, if their sanitary administration is carried out in the spirit of modern preventive medicine.

SECTION II.

ENGINEERING AND ARCHITECTURE.

ADDRESS,

By JAMES LEMON, M. Inst. C.E., F.R.I.B.A., F.S.I., F.G.S., &c., Mayor of Southampton.

PRESIDENT OF THE SECTION.

This Section includes a great many subjects; my predecessors in this chair, in most cases, have selected *one* subject, and made it the basis of their address. I propose to adopt a somewhat different course, and to take a general view of the aspects of sanitary engineering, leaving it to the writers of the various papers to deal with the various subjects in detail.

Sanitary engineering may be called a modern science, as it is only since the passing of the Towns Improvement Act of 1847, and the Public Health Act of 1848, that serious attention has been given to it. Investigations were made into the causes of zymotic diseases in towns, and it was found that want of efficient sewerage, defective house drainage, pollution of drinking wells, badly constructed dwellings, and want of ventilation were amongst the main causes of the high death rate.

The medical profession have always been pioneers in sanitary reform, and when they proved that certain diseases were preventable, public opinion called loudly for the removal of the causes referred to, the sanitary engineer may then be said to have been created. His sanitary knowledge, forty years ago, was extremely limited, he was a civil engineer, or an architect and surveyor, and in some cases a surveyor of highways, and he was suddenly called upon to sewer a town. Is it a matter of surprise that so many mistakes were made? ought we not to congratulate ourselves that there were not more? But it is a peculiar feature in the character of an Englishman that he rises to the occasion. The demand for sanitary knowledge

created the supply. Men of superior professional attainments took up the work, and to-day England stands in the front rank, America being her only competitor of importance. The sewerage of towns necessarily occupied an important position amongst the questions to be dealt with by the sanitary reformer, and a great controversy was commenced between the advocates of sewers, sufficiently large for men to enter for the purpose of cleansing, and the advocates of small pipe sewers—called by their opponents "the quart into a pint school," or the pot pipe party—but the sturdy common sense of our professional advisers, who looked at the question as scientists only, and not as party advocates, prevailed, and the drainage engineer of to-day designs his sewers according to the work they have to do. Small pipe sewers have, in the main, won the victory, because with proper gradients they are self cleansing, and the brick sewers of former times were ridiculously out of proportion to the quantity of sewage flowing through them. This leads me to the consideration of the principles to be kept in view as regards town sewerage.

I would give the fall the first place. All sewers should, if practicable, have a self-cleansing velocity. This fall will, of course, vary according to the size of the sewer, large sewers not requiring so much fall as small ones. It is a common error amongst inexperienced engineers to increase the size of a pipe sewer when the gradient is bad, in order to show that a self-cleansing velocity is gained; but if they would take the trouble to ascertain the wetted perimeter, this fallacy would be at once exploded.

The quantity to be dealt with is another important factor, as it necessarily influences the gradient of the proposed sewers. This will depend upon the water supply, and the rainfall to be provided for. I am glad to say there is a tendency to make a more liberal provision for the water supply per head per diem than was thought necessary a few years ago. Water closets are becoming more general, and baths in small houses are common.

In Southampton houses letting at only £26 per annum are provided with baths, and in some cases workmen's dwellings of only £16 rent are similarly provided; sewers are better flushed, roads are more frequently watered, urinals, courts, channels and gulleys flushed down; this all means more water, and with it a higher state of cleanliness and improved health. In small towns 20 to 25 gallons per head is sufficient, but in towns of 50,000 and upwards, 30 gallons per head should be provided.

I now come to a vexed question, viz., the rainfall. What is to be done with it? As it is not usual to discuss a Presidential

Address, I do not desire to deal with controversial matters, but still there are many questions of vital importance to sanitary progress which should be referred to and also discussed in this section, and if I point them out I may induce others to write or speak upon them. Amongst these questions I put the disposal of the rainfall. I am afraid the rainfall is dealt with in rather a perfunctory manner, even by drainage experts. Leave the rainfall alone says the drainage engineer, it got away before, why meddle with it? We don't want it in our sewers. I confess I have said the same thing myself, but there is a limit to this kind of doctrine. A damp subsoil has a detrimental influence upon the public health, and if a town is to be properly drained, the water level must be permanently lowered. I am quite aware that the sewerage of a district lowers the water level. I remember when the main sewer was carried through Nunhead by the Metropolitan Board of Works, the water level in the private wells was lowered, and in some cases the wells run dry, but this was due to the fact that we cut through the clay basin. This result is not, however, always obtained, it depends entirely upon geological causes, and the relative level of the district.

I wish to drive this question well home, because it applies very strongly to Portsmouth, and the very least we can do in return for the generous hospitality of the Corporation, the officers and citizens, is to try and deal with questions in which they are interested. A discussion of the pollution of rivers by the refuse from factories, would be useful to this Congress, but it does not interest the people of Portsmouth very much. Sir Frederick Bramwell stated in this hall at the meeting of mechanical engineers held in July last, in answer to a question from myself, that he had allowed for a quarter of an inch of rainfall in 24 hours in the calculations he made for the sewerage of the borough lately carried out by him. Now this is the Metropolitan scale, exactly the same as that adopted by the late Sir Joseph Bazalgette. It has failed in London and it has failed in Portsmouth, and it will fail everywhere where it is adopted under similar conditions.

It was all very well in those parts of the Metropolis north of the river Thames, where the old sewers, utilized as storm overflows, are above the level of high water, but in the south of London, where I formerly lived, and in other low-lying parts, there is no free outfall, and the heavy rains must either saturate the subsoil or flood the surface of the district and the basements of the buildings.

In London special supplementary surface drainage outfalls have been constructed, to remedy the defects that arose from the

defective design of the Metropolitan main sewerage, previously referred to, and in other towns where this scale has been followed the Local Authorities will have to adopt similar remedial measures. But what I wish to impress upon this Section in particular, and the Congress generally, is the importance of dealing with rainfall according to local circumstances, having regard to the rainfall in the district, the relative level of the district and the river or sea, and the geological conditions. It must not be left to take care of itself; it must be calculated and dealt with with as much care as the water supply. In low-lying districts it should be provided for by a duplicate system of sewers, and lifted by steam or other power above the level of high water.

In the foregoing remarks I have not specially referred to the separation of the rainfall from the sewers, although it might easily be inferred that my views ran in that direction. There are, no doubt, great advantages attending the separate system, more especially where it is necessary to treat the sewage chemically, or to dispose of it on land. In the first place, the quantity to be dealt with can be more easily ascertained, and consequently the sizes of the sewers and tanks, and the area of the land, more correctly determined. But what is meant by the separate system? If a duplicate system of drains to every house be meant, then I say at once it is not in my judgment either practicable or desirable, but if on the other hand it is only intended to exclude the rainfall from the roofs of houses draining to the front, and the surface of the streets, then my preceding remarks will apply.

Sea Outfalls.

As the Congress is assembled at a seaport town it may not be out of place if I say a few words as to sea outfalls. The Corporation of Portsmouth are very fortunate in having a large harbour, and rapid tidal currents which carry away the sewage from the town, the natural advantages referred to have been utilized to their fullest extent in the construction of the sewage storage tanks and outfall, and I have every reason to believe there is no return of sewage on the foreshore, and no nuisance; but the young engineer must not take Portsmouth as an example and adopt the principle somewhere else, where the local conditions may be altogether different.

Sea outfalls require the greatest care as to their placement and construction, and if the currents are not favourable crude sewage should not on any account be discharged from them. In cases of this kind precipitation must be resorted to, and the effluent only discharged into the sea.

Amongst the questions which are agitating the public mind is that of the ventilation of sewers. Inquiries are continually being made by local authorities, patents taken out, and experiments made by experts, but we are practically to-day where we were 30 years ago. The prevailing system is that of open gratings over the manholes in the centre of the streets, but this has the disadvantage in some cases of causing a nuisance to passers by and to the occupiers of adjacent dwellings. To remedy this defect, connections have been made between the manholes and existing chimneys, the result has been satisfactory, but the area ventilated has been so small that it is only a partial remedy; another mode is the erection of pipes against the walls of buildings, as outlets from the manholes or Sewers.

The use of charcoal trays in manholes was at one time strongly advocated, but that mode seems to have died a natural death. The trays were found to obstruct the ventilation, and after a short time, the charcoal was of doubtful utility. I was never in favour of this mode, but I have used charcoal trays, as I found them useful as a remedy against sentimental objections. I remember a rather amusing incident in reference to them: a gentleman in Southampton, who resided opposite a manhole, asked me to put in some charcoal trays, as he was confident they would remove the smell of which he complained, I ordered the trays to be put in, which was done, but, unfortunately, the man forgot to put in the charcoal, my friend saw the manhole opened and the trays put in from his window, and after the man was gone he went down on his hands and knees to try if there were any smell, he was so convinced of the efficacy of the charcoal that he wrote to me and reported that the smell was entirely removed; when I told him that the charcoal was non-existent, he was, of course, very much astonished. This is a sample of some of the sentimental objections which are sometimes raised to ventilators. Another mode of ventilation which has lately come to the front is the invention of Mr. Holman Keeling, which he calls a destructor, it consists of a vertical cast iron lamp standard, with the ordinary street lantern, and fitted with a gas furnace for the burning of the gases from the sewer.

I do not think I can do better than allow Mr. Walker, the well-known Borough Engineer of Croydon, to give his experience in his own words. He says: "We have allowed all comers to try anything that any inventive age could suggest, most of them not worth a moment's consideration."

"One of Keeling's Destructors has been well tried, with results far better than any other. It was placed on high ground on the apex of a 9-inch sewer, and in the 6-inch pipe connected with it, an anemometer was placed for many weeks,

registering the speed of air passing from the sewer to the Destructor. The average was 1507 cubic feet per hour, with 8 cubic feet of gas consumed in the burner, and the temperature of the air inside the column, four inches above the burner, was 190° Fahr. This was tested last April (1891), the Destructor having all the recent patented improvements in it. At the same time, I found, by placing similar anemometers in the ventilating pipes in various parts of the Borough, that the average was 1852 cubic feet per hour. The patentee expressed his satisfaction with the result of the test of the destructor, and I am sure the Association of Municipal and County Engineers will agree with me that the average amount of sewer air passing up the ventilation pipes was eminently satisfactory."

"A special anemometer has been used that does not unregister, if the current is reversed. If the anemometer was reversed, it would register the down current only."

"We have about 250 pipe ventilators in use, chiefly up houses, and almost every week others are put up: where a sewer-ventilator smells, or is supposed to do so, there is very little difficulty in getting permission to erect a ventilation pipe. This is done on the understanding that it is taken down in 24 hours if the owner or occupier requests it."

I think it is unnecessary for me to express any opinion upon these experiments. They are so clear, they speak for themselves, and the members of this Section will draw their own conclusions; I will say, however, that Mr. Walker has been more successful than most engineers in obtaining the consent of the owners and occupiers to the erection of ventilating tubes against the houses. I have invariably found that a very small percentage will give their consent.

In my own practice I place the manholes about 100 yards apart, with gratings thereto to open or shut, and also put as many shafts and tubes as I can. The manholes will in most cases act as inlets for fresh air, and the tubes as outlets, but if the current be reversed no harm is done, as there is a continual change of air in the sewer.

I consider you cannot have too many inlets and outlets to a sewer, and after 40 years' experience I have come to the conclusion that an open sewer down the centre of a street, with a good fall, would be the best form of construction; that is, however, impracticable. I therefore say, get as near to it as you can. When a deputation waited on Sir Robert Rawlinson and complained of the smell from the ventilators in their town, He replied, "Put in some more." When a ventilator smells the local authority generally orders it to be closed; greater folly cannot be committed, you cannot bottle up a stink. If you

will not have it in your streets, you will most probably get it in your houses. It is evident that the sewer is badly constructed or that it wants flushing.

This leads me to repeat an opinion I have so many times expressed, that if we had properly designed and constructed sewers we should hear very few complaints of the want of sewer ventilation. Noxious gases (of which we hear so much) cannot generate in a sewer with a self-cleansing velocity. Happily, we are making rapid progress, the sanitary engineer of to-day is very different to what he was 30 years ago. He is now a gentleman of education, and properly trained for the work he has to do; and as sewerage works are properly designed, so will the present sanitary defects disappear.

I have dealt with some of the main points of the sewerage of towns without attempting to discuss the details, in the hope that they will form the subject of a paper before this Section, and be fully discussed. The disposal of the sewage of towns is too large a subject for me to refer to in a brief address, but I desire to refer to the question as it presents itself up to date. We have lately seen the system of precipitation growing more into favour. This is due to several causes: first, the improved means of disposing of the sludge; secondly, the failure of so-called sewage farms; and thirdly, the growing tendency to combine precipitation with land filtration. As regards sewage irrigation and intermittent filtration, I believe the failure is due to the adoption of unsuitable land to save pumping, and to the letting of the land by the Local Authorities to tenants who naturally look to making a profit and care little for the successful disposal of the sewage.

Healthy Dwellings.

Although the successful sewerage of a town is a most important consideration, we must not overlook the health of our dwellings. We are now face to face with a cholera epidemic, and every Englishman should put his house in order, and every Local Authority should strictly enforce the most improved regulations for the preservation of the public health.

I had considerable experience during the cholera epidemic of 1866, and I know the disease took a firm hold of those parts of the town which were in an insanitary condition. If you wish to resist an attack of cholera, you must have good sewerage, good house drainage, a pure water supply, and plenty of air space.

The towns of Hamburg and Havre are illustrations of this want of those essentials to public health. A physician of Hamburg says, "Unfortunately Hamburg is built contrary to

all rules of sanitation. The houses have no yards, and close behind are other houses—old, many-cornered, dark, and airless —the overcrowded habitations of the poor, filled with dirt, and ill-smelling. In addition, the Elbe is partly dried up, and on its banks is deposited all manner of refuse."

On the other side of the channel we have the large and important seaport of Havre, the normal death rate of which is more than double that of Portsmouth. In the year 1884, I prepared a Report on the sewerage of this town, the authorities appointed a committee of experts to sit upon it, but nothing has been done from that day to this. These two towns Hamburg and Havre, are in communication with this country, and they are sending forth a pestilential army to invade our shores, we may by constant vigilance, keep them out, but it is a scandal in these days of International Congresses, that such sanitary neglect in Germany and France is allowed to exist.

Fortunately for England, the local authorities are better prepared than they were in 1866; these Sanitary Congresses have educated the people, and the average Englishman now recognises the advantages which sanitary legislation has conferred upon him. But it is to the safety of the poor we have still to look, our towns are still overcrowded. Much has, however, been done in the last year under the Houses of the Working Classes Act, 1890. Houses unfit for habitation have been closed, but a danger still remains, and local authorities must face it, however reluctant they may be to do so. The occupiers of insanitary dwellings are removing to other houses in the locality, and so the overcrowding is still continued. What is wanted is the erection of suitable dwellings to take the place of those condemned, notwithstanding the fact the owners in many cases put the houses in a proper sanitary condition, and they are allowed to be reoccupied. Here is a splendid opportunity for the architect: to design a good healthy dwelling for the poorer working class, at a reasonable cost, so that local authorities may be induced to erect them. A good model working man's home is wanted in our crowded towns, where there is a large dining-room, and reading-room common to all, and a separate bedroom for each lodger; such a place for single men would be much sought after, and would always command good tenants.

Before closing this Address, I should like to say a few words as to the construction of houses for the middle and upper classes. It is assumed, and not unnaturally, that the well-to-do classes, as distinct from the poor, enjoy greater immunity from zymotic diseases, but that is not always so. The poor are more hardy, they have to rough it, they are less likely to take cold from exposure to inclement weather, and although they run far

greater risks from bad drainage, and from the wretchedly-constructed dwellings in which so many live, they to a certain extent become disease-proof, and escape from the dangers which would be fatal to the more delicately nurtured children and the more carefully housed, well-to-do-classes.

A man in moderate circumstances takes a house in the suburbs of one of our towns, or he may be induced to buy it. He does not consider it necessary to consult an expert, or he will not incur the expense; what is the result? He finds after a brief residence that some member of his family does not enjoy his or her usual health; the doctor is called in, and an opinion is expressed that there is "something wrong with the drains," or in other cases the water is found to be impure, or the house is damp or draughty from the shrinkage of the green material with which it is built. This is the common experience of every day life.

What is the remedy?

No man should take a house unless he has satisfied himself that it is in a proper sanitary condition. But, you say, who is to pay for this examination? My answer to that is, the owner, if he wish to secure a good tenant, should in his own interest do so. If the owner refuse, it is evidence that he is not prepared to put his building to a proper test; but he may say the house has been built under the supervision of Mr. A. B., a well-known and competent architect; in that case the tenant might be disposed to run the risk, but in the interest of his family and himself I should advise him to pay the small cost of an examination, he would then feel that he had done his duty as a father and a citizen.

While saying this much, I am quite willing to admit, that this want of confidence is due to the fact that we are too much in the hands of the jerry builder, and that on the part of some of our architects and builders there is not that knowledge of the Sanitary details of our houses there ought to be. Our dwellings should be above suspicion, and with attention to a few principles of sanitation and proper supervision of their construction they would be.

The Sanitary Architect (I have coined a new term), should insist upon the following points, viz.:—

1. A dry subsoil. If it be not naturally dry, he should make it so by land drainage. If there are no means of effecting this, do not build the house.

2. A damp proof course, either of asphalte or two thickness of slate in cement.

3. Walls built of hard kiln burnt bricks, which will keep out heavy rains, and in the Southern parts of England, hollow walls.

4. A good pitch to the roof and *outside* gutters, eaves' gutters if practicable.

5. Good ventilation under the floors, and to the rooms, by separate ventilating flues next the smoke flues as exits and proper inlets.

6. Drainage in stoneware pipes, outside the house, disconnected with the main sewer and ventilated. If compulsory to go under the house, then the drains should be laid in cast iron pipes, with lead joints like a water main.

7. Water closets should have flush-down basins, with the soil pipes *outside* the house, carried up the full size and ventilated.

8. Sinks of all kinds and baths should be disconnected with the sewers and discharge over open gratings.

These are eight of the principal requirements for a healthy dwelling, and if they be observed, we should hear very little of typhoid fever and other kindred diseases.

In conclusion, allow me to say, I congratulate the thriving borough of Portsmouth in receiving The Sanitary Institute. I am certain these Congresses have a tendency to raise the standard of knowledge and of thoroughness of work amongst my professional brethren. I do not wish to underrate in any way the labours of medical men, no man has a higher opinion of that noble profession than myself, but I would say to the engineer and architect of to-day, that as you do your work in the future and keep abreast of the progress of Sanitary Science, so will the onerous duties of the medical officer and the sanitary inspector decrease: you are the creator, upon you falls the labour and constant study necessary to design good sanitary works, upon you also rests the heavy and serious responsibility of proper supervision of your works in many cases performed by others under your charge.

Failure has resulted in some cases, but in the overwhelming majority, the engineer and architect performs the duties entrusted to him with fidelity and zeal, and he is fairly entitled to the confidence of the community at large.

Sir Charles Cameron (Dublin) said he had much pleasure in moving a vote of thanks to the President of the Section for his interesting and practical address. It was far more usual for Presidents to deal in platitudes and to bring forward abstract ideas, and very often abstruse ones, than to reason so much from the abstract to the concrete as their worthy President had done. His address had been practical and most suggestive, and they had all listened to it with pleasure and

profit. He had been particularly interested in the remarks Mr. Lemon had made with regard to the disposal of sewage in towns like Portsmouth, which were situated upon the sea-coast, for at the present moment they were engaged in Dublin in carrying out a main drainage scheme under the direction of a very experienced Sanitary Engineer, Mr. Chatterton, a Dublin man, though practising chiefly in England. The question of the disposal of sewage in towns upon the sea-coast had not yet, he thought, been completely studied, and there must be a great difference in the precipitation required in these towns, and in towns situated a long way from the sea, in which cases the effluent must necessarily be discharged into a river. In that case they had to deal with the perplexing question of the soluble organic matter, and to get rid of this was somewhat difficult, for though they might discharge an effluent, apparently pure, before it reached the sea, the matter separated and assumed a very objectionable form. From some experiments he had made, he had found that within twenty-four hours an effluent which had no odour whatever, became extremely offensive, particularly in warm weather. In Dublin it was not necessary to do anything more than to use the smallest amount of precipitating material to purify the sewage, for after discharging the effluent into the ocean they would never again see the dissolved matter contained in it. He had been much interested in the visit they had paid to Portsmouth Sewage Works, but they could hardly take the case of Portsmouth as an example of the way the sewage of other towns could be dealt with. At Dublin, experiments with corks and other devices had shown that a great portion of the crude sewage came back upon the shores, and, therefore, it was necessary to clarify the sewage to a certain extent. He had also made some experiments with regard to the ventilation of sewers in Dublin; at the present time in that city they had ventilating openings in all the sewers at comparatively short distances from each other. These were practically open sewers, and so far as emanations from sewers were concerned, it would be better to have open conduits through the streets were it practicable. Very unpleasant vapours at times came out of these openings, and the question had been raised whether it was any advantage to have so many of them. He had made a number of experiments on this subject in all parts of Dublin, at high and low levels, in poor localities and rich districts, and as a rule he found that the air was going into them and not coming out. He had tried it with delicate anemometers, and early in the day he found that the air went in like a whirl-wind, due, no doubt, to the currents created by fires being lighted in houses where the traps were defective, allowing the air to be drawn up. He thought there was not much pressure in sewers, and if proper precautions were taken to make properly trapped communications between the house drains and street sewers, he believed a very slight pressure would be insufficient to force the traps. But of course they would have to consider whether the sewage was always running or not. In Dublin the sewage was often impounded for eight or ten hours in the day, but even then the pressure was very slight indeed, from half an ounce to an ounce and often none at all.

In Dublin all the sewage went into the Liffey, the mouths of the sewer valves opening and closing as the tide rose and fell. These, however, would be done away with by the new sewage works, which would have a continuous flow.

Sir THOMAS CRAWFORD, K.C.B. (London), as Chairman of the Council of The Sanitary Institute, seconded the vote of thanks to Mr. Lemon for his address. He said that to Sanitary Engineers they owed much of their success in their efforts to educate the public upon these great questions of health. In his last paragraph their President was very complimentary to medical men, and speaking with the experience of from 40 to 50 years, he did not think the compliment was altogether undeserved. But as Director General of the Medical Department of the Forces he had always laid down and impressed upon his Officers, the point at which a line should be drawn between the good work to be done by Medical Officers and Sanitary Engineers. That line was distinct, and the Medical Officer's duty was to search out the cause of the disease, and if it was to be removed by Engineering skill to leave the remedy in the hands of the Engineer. Medical Officers could suggest remedies, but, as a rule, they did not know anything about engineering.

On "Apparatus for Softening Water," by HENRY LAW, M.Inst.C.E., F.R.M.S.

THE quality known as *hardness* in water is caused by the presence in solution of certain salts, and the process of *softening* consists in the more or less perfect removal of these salts.

Water may be softened in a greater or less degree by boiling, by distillation, by exposure, by freezing, by filtration, and by chemical re-action; and it is of this last process that it is proposed to treat in the present paper. The rationale of the process consists in adding to the water certain substances which re-act upon the foreign substances already contained in the water, forming new compounds, which, being no longer soluble, may be removed either by filtration or by precipitation.

The substances and the proportions in which those substances should be added to any particular water depend upon the chemical composition of the substances already contained therein. In the present paper it is not proposed to deal with the chemical question, but only with the conditions which insure the most perfect result, and the mechanical means by which those conditions are most perfectly fulfilled.

The process which has been most extensively adopted is that which was patented by Dr. Thomas Clark in 1841, and consists in the addition of a certain quantity of *lime* to the water to be softened. To explain the mode in which the lime so acts, it is necessary to state that the hardness in the water upon which lime will act is caused by the presence of bi-carbonate of lime, consisting of 9 parts by weight of lime, combined with 14 parts by weight of carbonic acid, forming a salt readily soluble in water. If now 9 parts by weight of lime be added to the water, it takes from the bi-carbonate half its dose of carbonic acid, combining with the same and forming 32 parts by weight of carbonate of lime, composed of 18 parts by weight of lime and 14 parts by weight of carbonic acid, a salt which is not soluble in water, and which is consequently precipitated, leaving the water free from the presence of the bi-carbonate of lime which it originally contained, the quantity of carbonate of lime precipitated containing double the quantity of lime previously existing in the water.

As in most waters bi-carbonate of lime is the chief cause of hardness, only lime is used for the purpose of softening the water; but other substances in addition to lime are sometimes used to re-act upon other salts of which lime and magnesia form the base. The action, however, is in all cases similar to that above described, namely, by the addition of certain substances the *soluble* salts originally contained in the water are decomposed and fresh compounds are formed which, being *no longer soluble*, are precipitated from the water.

Now, in order that this process may be carried out in the most perfect manner, the following conditions should be observed, namely:—

1. The substances to be added should be perfectly dissolved before being mixed with the water to be softened so that they may be presented to the substances to be re-acted upon in the most finely divided state possible, as this is necessary to insure perfect chemical action.

2. The substances so added should be neither in excess of, nor wanting in the due proportion required to re-act upon the substances contained in the water to be softened.

3. It is important (as was pointed out by Dr. Clark) that the lime, or lime water, that is the softening ingredient, be put into the vessel first, and the hard water gradually added, because there is thus an excess of lime present up to the very close of the process, and this circumstance is found to render the precipitation of the carbonate of lime produced in the process more easy.

4. Means must be employed to remove from the water the

insoluble compounds resulting from the chemical re-action; and this may be effected in one of two ways; namely—

(*a*) By subsidence or precipitation, or

(*b*) By filtration.

The most perfect means of fulfilling the first condition is to form a *saturated* solution of the softening ingredient which will then contain a certain definite quantity in any particular measure, and can be added to the water to be softened in the exact proportion required to react upon the salts contained in the same, and leave no excess of the softening ingredient in solution in the water at the conclusion of the process.

In order to obtain a *saturated* solution an excess of the softening ingredient should be mixed with water already softened in a separate tank or vessel; various methods have been adopted to insure a thorough mixture. At Luton Hoo there are two tanks into each of which an excess of milk of lime is poured, and they are afterwards filled with softened water to a certain fixed height. The contents are then agitated for about a quarter of an hour by a two-bladed screw, revolving in a short tube by which the water in the tank is kept in constant circulation. The screw is then lifted out of the tank and the excess of lime subsides to the bottom, leaving a perfectly clear saturated solution of lime.

The composition of the water to be softened being known it is easy to calculate what depth of water in the lime water tank will be required to soften a given quantity of the hard water, and this quantity is run off into the bottom of a larger tank into which the given quantity of hard water is subsequently poured.

By this method the first three conditions are fulfilled in the most perfect manner, the lime being first thoroughly dissolved and then mixed with the hard water in exactly the right proportion, and the water to be softened being added gradually to the lime water.

The contents of the tank are then left for some hours in a state of quiescence, during which the insoluble matter resulting from the chemical reaction gradually falls to the bottom of the tank, leaving the supernatant water perfectly clear. The precipitate thus deposited is not removed at each operation, but is allowed to accumulate for some time. When the hard water is poured into the tank this deposit is stirred up and mixes with the water, and assists in carrying down more rapidly the fresh insoluble matter resulting from the chemical action. At intervals varying from one to three months this deposit is run out of the tank. It is usual to have three softening tanks, one in process of filling, one in which the water after being treated is

in a quiescent state the deposit subsiding, and one from which the clear softened water is being drawn for use. This is the process as originally proposed by Dr. Clark, and is that which most perfectly effects the object desired and fulfils the conditions already laid down.

In practice, however, where the quantity of water required to be softened is considerable, a very large space would be necessary for the tanks, and to meet this difficulty various methods have been devised for carrying on the process continuously, the substance resulting from the chemical action being removed by *filtration* instead of by *subsidence.*

One great difficulty in the continuous process is to cause the water to be softened and the softening ingredient to be mixed continuously and uniformly in due proportions. Where the water is to be used for dietetic purposes this is essential, as an excess of lime or other re-agent would render the water unwholesome.

It has been sought to effect this object by supplying the hard water and the softening ingredient through two separate pipes, which are of such relative discharging capacities as will cause each to discharge the quantity required; but this is very difficult if not impossible to accomplish. For, however accurately they may be adjusted in the first instance, the smaller pipe which supplies the softening ingredient is liable to become partially choked by deposit.

Assuming that lime alone is to be used to soften the water, then each 700 gallons of water will require 1 oz. of lime to be added for each degree of hardness; so that if the water has 18½ degrees of hardness, 18½ ozs. of lime will be required to soften 700 gallons; then as 750 parts by weight of water is necessary to hold in solution 1 part of lime 751 times 18½ ozs. or 866 lbs. of lime water must be added to 7,000 lbs. of the hard water; that is to say the water to be softened must equal 8 times the quantity of lime water which it is necessary to add to it.

Where the softening process is carried on in open vessels it is comparatively easy to detect any want of proportion in the water and the lime, as the quantities being respectively delivered by the two supply pipes can be measured from time to time. It is, however, obviously frequently of importance that where hard water is supplied under pressure, it should be capable of being softened in close vessels under pressure. Under these circumstances it becomes extremely difficult to regulate the quantity of lime added, or to detect any want of due proportion in the same.

A great number of patents have been taken out having for

their object the removal of these difficulties; but as far as the author knows there are not any which have been entirely successful. When the water is thus confined in vessels under pressure, it is obvious that the process cannot be continuous, but must really be intermittent. For unless water is being drawn from the vessels, neither hard water or lime water will be flowing, the whole of the contents of the closed vessels being stagnant. When water is drawn a current will be produced causing a quantity equal to that withdrawn to enter the vessels, but it is difficult to conceive any arrangement which will ensure one-ninth of the required quantity always entering by the smaller pipe and eight-ninths by the larger pipe, as so many varying conditions will tend to cause a greater or less discharge from either of these supply pipes.

The largest installation as far as the author knows to soften water for domestic supply is that which has been carried out by Mr. William Matthews, at Southampton. The process here adopted is to deliver the hard water from the pumps into the head of a trough with baffle plates, the lime water being allowed to flow into the same by gravity in a regulated quantity, the agitation of the water and the action of the baffle plates being relied on to insure proper mixture of lime water with the water to be softened. The mixed water thence flows into a tank 76 ft. long, 42 ft. 2 in. wide, and 6 ft. deep at one side, sloping to 7 ft. at the other. The water is about one hour in passing through this tank, escaping at the further end over a cross wall 4 ft. 9 in. in height, so that the surface water only passes over the same, and a certain quantity of deposit is thus arrested in the tank.

In order to remove the remaining deposit, the softened water is passed through filters, which are described as follows by Mr. Matthews in the Paper* supplied by him to the Institute of Civil Engineers:—

"Water is admitted to the filters through horizontal 6-inch pipes, terminating, in the softening tank and supply tank, with bell-mouthed bends, in which heavy leather-faced valves are fitted, actuated from the front of the filters by levers and chains. Each filter consists of an open tank, cast in one piece, $\frac{3}{4}$-inch thick, $7\frac{1}{2}$-feet long, and 3-feet $7\frac{1}{2}$-inches wide; the ends are vertical, 6-feet deep on the centre line; while the bottom falls 3-inches each way towards the centre. The tank is V shaped in cross section, having a radius of half the width. The inlet enters through the back plate, $9\frac{3}{4}$-inches above the bottom, where a socket is cast in the plate, and the joint made with lead.

* Minutes of proceedings of the Institution of Civil Engineers, Vol. CVIII.

A 6-inch bend is bolted to an opening in the bottom of each tank, and discharges the waste through a pipe and valve fixed under the floor, into a line of 12-inch pipes running the whole length of the house, and communicating with the drains outside. The valve is worked by a lever from above the floor-level. A cast-iron cross bearer is fixed across the back of the tank, and carries a brass-lined bearing fixed on the centre line, 4-feet $2\frac{1}{4}$-inches below the top; while a corresponding trunnion bearing is formed in the front plate of the tank. These serve to support the cast-iron disc shaft, which is $5\frac{1}{2}$-inches in diameter, and is hollow, closed at the back end, and has grooves and openings in it, so that the water from the discs which it carries may be admitted to the central portion. Near the front end a spur-wheel is keyed on, and is driven by a pinion and short shaft, which works through a stuffing-box formed in the front plate of the tank, and is actuated on the outside by bevel gearing and shafting arranged along the front of the filters, and driven through belting from a line of shafting supported on the walls above them.

"Each hollow shaft carries twenty galvanized cast-iron discs of light open work pattern; they are 3-feet in diameter, and $\frac{7}{8}$-inch wide, and are covered on either side with perforated zinc sheeting, over which is stretched stout twilled cotton cloth, which acts as the filtering medium, the cloth being held in position by clip-rings and studs, which secure it at the periphery of the disc. Galvanized cast-iron distance pieces are placed between the discs on the shaft to keep them the requisite distance apart of $3\frac{1}{2}$-inches from centre to centre.

"The turbid softened water, being admitted to the filters, percolates through the cloth into the discs, whence it passes to the hollow shaft, and through the trunnion to a valve fixed on the front of the filter, which regulates the flow into the softened-water tank formed under the filter-house floor. The water is now in a perfectly clear state, the precipitated bi-carbonate of lime having been arrested on the face of the filter cloth, whence its removal is effected by means of water jets. Between the discs, $\frac{3}{4}$-inch spray pipes are placed, capped at their outer ends, and pierced on either side with small holes or slots. These pipes are connected by T-pieces to a $2\frac{1}{2}$-inch pipe, fixed along one side in each filter, closed at the back end, and mounted on a pivot; while the front end passes into a trunnion formed in the tank plate, and communicates with pipes and a regulating valve supplied from the high-pressure service main outside the building. The outer ends of the small spray pipes are fixed to a bar; and the whole set can thus be raised or lowered between the discs, the $2\frac{1}{2}$-inch pipe being free to

revolve in its bearings. The pipes are raised by a chain wound on a small drum, to which motion is given by worm gearing and a hand wheel placed conveniently on the front of the filter.

"The operation of cleansing a filter is as follows:—the inlet valve being closed, the water filters away, leaving the tank nearly empty; the outlet valve from the disc shaft is then closed, and the waste valve opened; next the disc shafts and discs are set revolving, and at the same time the spray valve is opened, and jets at high pressure are discharged from the spray pipes. These being raised and lowered between the revolving discs, the whole surface of the cloth is swept by the spray, and deposit washed off and carried away through the waste pipes, leaving the filter again fit for use. With the thirteen filters working, the operation of cleansing, which occupies under two minutes, has to be repeated every seven or eight hours, when the plant is passing water at the rate of $2\frac{1}{4}$ million gallons in twenty-four hours."

The filters above described were invented and patented by Messrs. Atkins, and it is stated that the cloths have a life of over eight months, filtering day and night continuously.

As an example of water softening on a large scale by the continuous process in closed vessels under pressure, on the system invented and patented by Mr. H. Porter, and generally known as the Porter-Clark system, the apparatus at the Penarth Dock Station of the Taff Vale Railway near Cardiff may be referred to.

The hard water and lime water in the proper proportions are admitted into a closed cylindrical vessel, 4 ft. 9 in. in diameter and 20 ft. in height, the contents of which are kept in constant agitation by revolving T-shaped vanes. From the top of this vessel the softened water is carried by a pipe to the bottom of a second cylindrical vessel, 7 ft. in diameter and 20 ft. in height, in the lower part of which are shelves so arranged as to baffle the water in its passage to the top of the vessel, from whence it is carried by a pipe to a third cylinder similar in construction and size; and from the top of this last vessel it is conveyed to the filter presses, which are of the usual construction employed to press sewage sludge. It is stated that a square foot of filtering surface will supply filtered water at the rate of 30 gallons per hour, the amount varying according to the pressure under which the filtration takes place. On an average the cloths are changed after being used about twelve hours, and after being cleansed in a power-washing machine are ready for further use. A full description with drawings of this apparatus will be found in a Paper by Mr. W. W. F.

Pullen in Vol. XCVII. of the Minutes of Proceedings of the Institution of Civil Engineers.

It is found with these filters, in which cloth is the filtering material, that the carbonate of lime which is deposited upon the cloth in very fine crystals becomes itself a very perfect filtering medium.

Sir CHARLES CAMERON (Dublin) asked what would be the estimate cost per million gallons. He also enquired whether the operation, explained by Mr. Law, was applicable to water, which having been filtered at a distance from the town where it was used, was received into a service reservoir. Very often solid matter made its appearance in such water, especially small crustaceans and even eels. The water works at Dublin were from twenty-five to twenty-six miles from the city, and the water was brought within five or six miles, and then stored there about three weeks. But they found that small crustaceans and eels and organic matter subsequently made their appearance in the pipes. He had advocated filtration from the service reservoir, and that the water should be used as soon as possible after filtration.

Mr. ROGERS FIELD, M.Inst.C.E. (London), said there could be no doubt that the process described by Mr. Law was a very valuable one, and it would be a good thing from a sanitary point of view if it were adopted more largely. For softening large quantities of water for public supply the process could be carried out with the greatest advantage, and with increased knowledge by the public on this matter he had no doubt that pressure would be brought to bear on Water Companies and Corporations who owned Waterworks, to soften the water they supplied when it was hard. That could be done effectually, and there was no very great difficulty in it as long as it was done on a large scale. Where, however, the water was not softened on a large scale difficulties did arise, and especially when it was a question of a domestic process applicable to small houses, as the smaller the houses the less inclined their occupants were to have trouble and to provide a series of tanks. To overcome this objection various arrangements of taps had been invented for supplying the lime water and the hard water together, and at first sight these looked very simple and nice. Some years ago, however, he made a careful investigation into the different processes there were for softening water on a small scale, and took trouble to find places where they had been in action for a considerable time. Then he discovered the difficulty there was in practice, viz., that the taps which had to supply the lime water were very liable to choke up, with the result that they failed to give the right proportions between the lime water and the hard water, so that the softening process was not properly carried out. He was afraid that the apparatus had yet to be invented

which would enable them to soften water satisfactorily on a domestic scale in small houses. With regard to the softening of public water supplies, however, there was not a shadow of doubt that it could be done, and done cheaply. The expenses would be exceedingly small, and he thought the Water Companies and Corporations which owned Waterworks, would be well advised in adopting it. To take only one item of saving, the money people paid for having their hot water pipes cleaned was more, he had no doubt, than the small extra charge they would have to pay in consequence of the public water supply being softened.

Mr. William Whitaker, F.G.S. (Southampton), said that Mr. Law had pointed out a difficulty in getting the proper mixture of the lime water and the water it softened. That, however, in his opinion was to a large extent a theoretical difficulty, for in all large softening operations you did not want to thoroughly soften the water; so that there need be no excess of lime water used. In the Southampton Waterworks the original hardness of the water came to about 18°, and Mr. Matthews, the Engineer, softened it down to about 8°: below which was too soft. As far as the Sanitary advantages went, he did not think there was much difference between hard and soft water; but it made a great difference to boilers, and it was really an Engineering and not a sanitary matter. There was a difficulty in getting rid of the residual deposit, and he believed there was an opening to make a profit out of this waste product. "Make Whitening out of it" might be said, but unfortunately this residuum was not a mechanical but a chemical precipitate, and whitening could not be made of it, for it would go off almost at a breath. The question was asked by Sir Charles Cameron as to the cost per million gallons. At Southampton, roughly speaking, the cost was $\frac{1}{4}$d. per thousand gallons, and this would make the cost per million something between a pound and a guinea; in deference to Sir Charles' professional feelings he would put it at a guinea. At Bedford, a town of about half the size of Southampton, the cost was estimated at about $\frac{1}{2}$d. a thousand gallons. It was a curious point about Water Companies that while they pooh poohed the idea of softening water for the public use, they sometimes took care to soften it for their own boilers.

Dr. Axford (Portsmouth) said that as a medical man he must take exception to a remark which had fallen from the last speaker, viz., that from a sanitary point of view the matter was of little consequence. He contended it was a matter of the greatest importance. The water of Portsmouth was hard, and as a consequence he had cases of disease come under his notice entirely due to the hard water. The hard water we used no doubt produced skin diseases, and in some localities it had been known to produce stone in the bladder and kidneys.

Mr. Frank R. Chappell (Portsmouth) contended that the important factor in this discussion was the question of cost. It was a pity

that no comparative statement had been made, showing on one side the cost of softening the water, and on the other an approximate estimate of the loss to the community, by the use of hard water, through the great waste of soap and the destruction of hot water pipes and boilers. It must also be considered that soft water was not wanted for many purposes such as flushing sewers, &c. Generally speaking he did not think that water containing from ten to twelve grains of hardness per gallon required softening.

The President of the Section (Mr. James Lemon) said that with regard to what has been said the Corporation of Southampton were fully alive to the importance of not using too much soft water, and they had used water from other sources for watering the streets. That system would be extended to save the cost of softening, and it did seem absurd to use the beautiful clear softened water for watering streets and flushing drains.

Mr. H. Law, M.Inst.C.E. (London), in replying on the discussion, said that Mr. Whitaker had sufficiently answered Sir Charles Cameron's question with regard to the cost. In works like those at Southampton, where they had machinery, the cost was greater than where they had settling tanks. In the latter case the cost amounted to little more than the lime and the pay of one or two workmen to carry out the work. Undoubtedly filtration might lessen the hardness, but in answer to Sir Charles Cameron's second question he should reply that the softening process was applicable for all the hard ingredients of water, which would be removed by boiling it. He desired to emphasize all Mr. Field had said upon the subject, for that gentleman had had a very large experience in observing the working of small softening apparatus for domestic supply. With regard to getting rid of the sludge, it was found to be a very valuable top dressing for land, and in some works, as at Luton Hoo, the sludge was taken from the bottom of the tanks and put upon the land. It also made very valuable tooth powder.

On "The Cause and Prevention of Typhoid Fever," by W. R. Maguire.

The limited amount of time allowed for the consideration of the subjects brought before this Congress compels an abrupt brevity not always undesirable.

The prevention of typhoid fever is a subject worthy of close attention, even when briefly considered.

To prevent any occurrence of disease we must know something of its nature, its causes, and its antidote.

Sir Charles Cameron, the President of this Congress, has clearly described typhoid fever as "distinctly a germ disease, caused by specific germs which exist in the infected soil, and ascend into the atmosphere at some seasons in greater numbers than in others."

Dr. J. W. Moore, of Dublin, states in his recent work on eruptive and continued fevers, that "since the discovery of Eberth's Bacillus Typhosus, and the establishment of its causal relation to enteric fever, the doctrine of the *de novo*, or spontaneous origin of the disease, whether without or within the body, has become untenable. Enteric fever arises only when the spores of these specific microbes enter the body, especially the intestinal canal, of a susceptible individual."

But the state of health which accompanies habitual constipation, with fœcal decomposition in the intestines, the result of that constipation, enormously increases the susceptibility of an individual, and in fact acts so powerfully as a *predisposing cause*, as almost to appear to be the exciting cause of an attack of the disease. Under such circumstances a very minute dose of the specific poison will suffice to kindle an attack of enteric fever.

Enteric Fever probably arises in the following way: the specific bacilli, or rods, form spores inside the organs of one sick of the disease, especially in the mucous membrane of the small intestine. The micro organisms are then discharged with the motions in their most resistant condition, *i.e.* as resting spores, and thus pass into leaky or faulty drains or cesspools, or into the ground. In these situations they may remain quiescent and harmless for a long time, for want of suitable nourishment or temperature. At last these spores arrive by chance in a body capable of being affected, and there they develop into bacilli, to begin anew their cycle of existence.

These germs of typhoid may be transported on currents of air. If they are inhaled and drawn into the lungs pythogenic pneumonia may be caused. If they come into contact with pure water, milk, or food they may be conveyed thus to the human intestine, there to breed and develop typhoid fever, and the period of recovery may extend from four to twelve weeks. The incubatory period is uncertain, but is some time under twenty-one days.

The stools of typhoid patients cannot when fresh, communicate the disease, but within twelve hours the infectious properties may be developed. All typhoid dejections should therefore be destroyed by some powerful disinfectant. Certain peculiarities of constitution seem to favour an attack of typhoid fever,

and others seem to give protection. Through constant exposure to the poison the human system apparently becomes habituated or inured to its evil effects; enteric fever has thus some resemblance to dysentery, ague, and malarious fevers. Removal from a healthy locality into an infected one is a powerful predisposant to typhoid. One severe attack generally protects the individual from liability to a second; but well-authenticated cases have occurred of typhoid fever contracted a second time. Typhoid is most prevalent in autumn, and it attacks rich and poor alike; overcrowding, on which typhus fever thrives, cannot be said to cause typhoid. Enteric fever may be communicated to others from the decomposition of infected excreta —outbreaks of typhoid can usually be traced to direct infection or poisoning of air, water, milk, or food, with decomposing infected excrement. The coming and going of epidemic diseases such as typhoid fever depend upon a combination of conditions. Upon season, temperature, rainfall, atmospheric pressure; upon rising, falling and flowing of underground waters; upon water supply, drainage and other sanitary conditions. The effects of these can best be studied as they occur within towns or districts which have been for long years occupied by man and subjected to continued accessions of pollution.

In old cities, where the old sewers and drains originally intended for rain and surface waters, roughly built of masonry or formed defectively of unjointed pipes, having flat gradients, tide locked at the outfalls, have been employed to carry or to receive yearly increasing volumes of excreta, it is plain that the subsoil and the undergronnd water must become saturated with sewage matters. It is in such districts where fœcal impurity accumulates in the subsoil that typhoid is disseminated by the introduction of contaminated underground air into dwellings, and that cholera and typhoid are spread where the drinking water is drawn from wells; these results occurring markedly in certain conditions of the atmosphere, and influenced by the movements of the underground waters. During a dry warm summer the ground-water level falls and draws volumes of air into the ground to replace it; the subsoil impurities pollute this air in some years more than in others, the extent of pollution depending on the condition of the ground, on the length of time the air remains in stagnant contact within it, and on the meteorological conditions of the pressure, moisture, and temperature of the atmosphere. When at the end of a dry hot season the rain falls on the surface of ground thus impregnated with foul air, it seals up the surface pores of roads, streets, and yards through which the air had previously been drawn down, but the underground pores remain laterally open right and left, affording

free passage to the polluted air pent between the falling and rising waters, above and below, whence it is forced through dry foundation walls and basement floors of dwellings, whose pores are open and unsealed by rain water. And as it is an almost universal practice for householders to allocate basement rooms for use as larders, pantries, dairies and kitchens, to say nothing of servants' bedrooms, the persons there living, and the food and drink therein stored, receive the first concentrated impact of the incoming flow of polluted underground air and absorb the infinitesimally minute impurities so conveyed to them.

As a general rule, to which there are also exceptions, it has been observed in populous districts that when the ground-water has remained sometime very low and is beginning to rise, driving out the ground-air, disease becomes prevalent. When ground-water is falling and drawing in the air diseases abate in virulence. The first flow of rain or percolation through the ground, from any cause, after a long dry season is favourable to the spread of typhoid. The fluctuations in ground-water level vary greatly according to the locality, from 100 ft. in some inland places to a very few feet close to the sea shore, the smallest amount of rise and fall giving the best sanitary results. Low water years are usually unhealthy periods, and high water years are healthy; but high water rapidly following low water gives rise to epidemics of typhoid. Pettenkofer showed by his investigations at Munich a close connection between typhoid and low water level, owing to the fact that drinking water was chiefly derived from wells into which the polluted subsoil waters had drained. The American records bear out these observations. In these countries in towns where pure water supply is provided, typhoid fever tends to prevail in Autumn when ground-waters reach their lowest level and then commence to rise.

The typhoid death-rate during the outbreak in Paris, 1882, clearly followed the lines of the rainfall there. Mr. Durand Claye published official records showing that the fever first appeared after a rise of ground-water, and the outbreaks investigated in this country also confirm that observation.

Outbreaks of typhoid have been traced repeatedly to special dates of heavy rainfall following low ground-water periods.

Old cities and towns in addition to other insanitary conditions, are usually honeycombed with old wells, and these receive contamination from defects in drains and yard surfaces; the polluted waters flow on percolating unceasingly underground towards the river and the sea, and carry the impurities a certain distance through the soil, distributing the pollution thus to an extent little understood or realized. The impurities accumulate

in the subsoil while the waters pass on purified as by filtration, and if among these impurities the bacilli of typhoid be existent, we can understand how that disease is spread. Strange as it may appear, the introduction of improved water supply to such cities, by causing the old wells to be disused and to overflow, seems to increase rather than to diminish the prevalence of typhoid fever. Sanitarians become responsible, knowing these facts, to use their influence in warnings, advice, and practise to preserve the ground on which dwellings are erected in town or country from all such contamination, whether from polluted rivers, or foreshores of the sea, from defective main sewers, from leaking house drains, surface soakage from stables or farm yards, streets and roads, or from pollution by any cause of the underground waters.

Experience and reason thus point to the free underground waters in polluted malarial condition as one of the chief cultivators and carriers of typhoid fever. The best way to preserve a city from epidemics of typhoid fever is to render the subsoil underground waters pure by means of perfect drainage and pavements. In cities built on tidal rivers intercepting sewers carried along the river banks will cut off that main artery from sewage contamination. The citizens are thus relieved from the twice daily back flow of foul waters through the sewers and subsoil, a certain cause of typhoid. The foul sewage will be more rapidly removed, but all the street sewers and house drains should be rendered self-cleansing, impervious, and otherwise perfect, so as to prevent the escape of dangerous sewage matters into the surrounding subsoil and to preserve the purity of the underground waters.

Nothing will deliver our cities from the curse of typhoid until something is done by law or otherwise sufficient to ensure that every public sewer and every house drain, and every branch drain and every junction, is sound and efficient to fulfil its intended purpose, to convey every drop of foul liquid and every particle of solid matter which enters them to a safe outfall; until every yard surface is paved with impervious pavement, over which every drop of water that falls on it shall be carried direct to its proper gulley-trap; until every street is so paved and graded that all its surface-waters shall be caught and conveyed to its special conduit, and nothing suffered to pass into the subsoil; until every sewer under every street is rendered air-tight on its inner surfaces, and quickly self-cleansing by proper falls or proper flushing; until the products of human and animal combustion are carried away within the twenty-four hours and disposed of in some harmless manner.

The pollution of the air we breathe, and of the air which surrounds our food and drink, follows this pollution of the earth, and of the waters under the earth, as surely as the night follows the day.

This communication of the disease is effected most frequently by drinking-water which has been infected by the specific germ. Professor Brouardel tells us that the proportion of 80 per cent. of typhoid cases investigated by him, and traced to their sources, was due to infected drinking-water; and in this country the disease has occasionally been traced to the milk supply, which had evidently been infected by abnormal contact with impure waters.

What, then, constitutes impure waters?

Strangely enough, the purest water most greedily absorbs infection when exposed to polluted air. Hard waters, whether stored in private wells, in public reservoirs, or in distributing house-cisterns, when impregnated with carbonate of lime or magnesia, will resist pollutions from the surrounding atmosphere, while pure soft waters will absorb them rapidly. Hard waters are unsuitable for domestic purposes, yet they are said to be the most healthful waters for drinking; but I belive that pure soft water, such as that supplied from Loch Katrine to Glasgow, and from the river Vartry, in Wicklow, to Dublin, while pre-eminently suitable for domestic use, should be also the most wholesome for drinking, except where such water is exposed to impure air rising through and from an infected subsoil, which attacks and dangerously pollutes that class of water in such circumstances.

Milk, meat, food of all kinds stored in basement rooms and larders, or in meat safes in yards and confined spaces, are liable to this infection from polluted air, and may thus become vehicles for conveying the infection to susceptible persons. Enteric fever or typhoid is an ubiquitous disease found in all countries and in all climates,—in Iceland, as in the tropics—and it is endemic, dwelling, unfortunately, among the people of the Continent and of the United Kingdom and Ireland, and wherever human beings hold intercourse.

The period of the maximum activity of the typhoid germs when the disease assumes epidemic proportions is determined by meteorological conditions, and perhaps by the annual autumnal debility and decay manifested by nature in the change and fall of the leaves, and in the miasmatic autumnal vapours which we observe hanging close above the ground, and in the autumnal failure of health-giving sunshine and daylight. We find at this same period of the year hundreds and thousands of dwelling-houses, especially those belonging to the wealthy class, unoccu-

pied during the long summer days, and whose probably defective insanitary arrangements, disused, neglected, untrapped, and unventilated, are suddenly at this coincident period brought into use, the houses occupied by returning families with children and servants who had been residing during the summer months away in purer air at the seaside, or enjoying continued out-of-door life in the brighter sunshine of other countries.

We find the autumnal change of temperature also affecting the question; for while the summer air outside the dwelling-houses is warmer than that within, no fires are burning under the chimney flues, all windows and doors are opened day and night admitting the outer air direct, instead of, as in winter, drawing it up through the ground; and all this healthful process going on during June and July, making them our two healthiest months; then comes a change, soon followed by the rise of typhoid fever, sick and death-rates. Families return, autumnal chills set in with copious rainfalls following dry seasons in these islands. Doors and windows are tightly closed, fires begin to glow, and heated chimney shafts to draw in air which must rise through the ground polluted from subsoils infected by leakages from defective drains and sewers and subsoil waters; this underground-air, gathering pollution as it passes, rises through foundations, walls, and floors, into basements, where it silently contaminates the food and drink stored in cool basement, cellars, and pantries.

And moreover, in cities these underground pollutions are carried by the flow of subsoil waters from house to house and from well to well; so that although one house may possess perfect drainage arrangements, it may unfortunately suffer from underground pollution communicated from defective drainage of the surrounding houses.

The movement of pure ground-waters under pure ground, rising and falling and flowing onwards, would cause health and salubrity, it is the pollution of ground-water which renders it a source of danger. Stagnation of every kind is allied to death, whether of the contents of the veins, the intestines, the house drains, public sewers or underground waters.

In country houses the same dangers may arise if underground waters are allowed to become contaminated from cesspools, defective drains, stable and farmyard surface soakage.

But in towns and suburbs we find many sewers (and we have no choice but to connect our drains into them) loaded with foul deposits from two to twelve inches deep, giving off foul gases which are both offensive and dangerous. These deposits are caused by the insufficient fall or by the needlessly large dimensions or improper sections of the sewers, which defects prevent sufficient

cleansing scour. Other sewers are subject to tidal back-waters, which cause deposit, or are built so close to front walls of houses as to be a constant danger to the residents.

It is a common practice in town houses to carry the house drains crossing the house out under the scullery, which is usually placed under the hall steps, and thence out under the communicating coal vault direct to the public sewer, which often happens to pass close by the coal vault wall; this practice I have condemned for the last 15 years as dangerous. The proper course for the house drain is across the open front area, in order to secure an effectual open-air break between the public sewer and the house wall.

This technical point, which is one of the most important details of town house sanitation, needs to be insisted upon strongly, for the public, and, indeed, many sanitary contractors seem unable to appreciate its importance.

To prevent the entrance of typhoid and other germs all house drains should be cut off or intercepted from the main sewers. Otherwise the main sewer, which carries or contains, as the case may be, the excreta of all the infectious diseases of the city—poured into it from fever hospitals and from infected houses—sends its polluted air up the house drains and pipes, whence it is infallibly drawn into the warm houses through every defect and through imperfect traps, especially when at night the doors and windows are closed. Physicians have frequently given testimony to the nocturnal retrogression of their patients suffering from typhoid fever from this cause.

Intercepting traps on drains are generally much too large; 6, 9, and even 12-inch traps have been removed by the writer from drains of houses and replaced by 4-inch traps, with the result that although the large traps caused frequent stoppage of the drains and all attendant dangers, the smaller traps have never given any trouble, because every flush of water is sufficient to cleanse them fully. The drains themselves are also too large, but it has been clearly demonstrated that where 6, 9, and 12-inch drains were formerly used, 4, 5, and 6-inch drains are more efficient, cheaper and safer.

It is understood now that interception means much more than trapping a drain. It is of equal importance that, in addition to the trap, an ample open-air space shall be provided between the trap and the house drain—this space may be covered by a grating or remain quite open, to act as a fresh air inlet for the ventilation of the drain. If this grating becomes choked by leaves or dirt, so that fresh air has no longer free purifying access to the drain and trap, then the interception is nullified, and the drain is placed in single-trapped con-

nection with the sewer. Care must be taken, therefore, to prevent this danger of the closing-up of gratings.

When placing intercepting chambers or intercepting traps on drains in areas, which is the proper position for them in town houses, it should be remembered that the area is a confined space, and that the basement windows, and generally a scullery or kitchen door open upon it; therefore, that air in the area is drawn direct into the house at these doors and windows. Therefore, the open grating on the drain should be safely arranged, so that in the event of any return of drain-air back through the grating intended as an inlet for fresh air, this foul air shall not be drawn into the house.

It is a good plan to extend the open-air inlet by means of a tube right up out of the area and to carry it through the foot-path parapet wall to the street, fitted with a vertical grating where the air will pass freely in, and where a chance return of drain air shall not enter the house. These return whiffs of drain-air will not occur if the vent shaft arrangements are properly formed and extended above the highest roofs in front or rear. Extract shafts should be treated just as the flue of a stove—the exit carried to a high point above windows and roofs, where foul air may pass away as freely as if it were smoke from a flue. And then the draught on this flue or vent shaft must not be spoiled by carrying other and lower rain pipes or vent shafts into it from lower return roofs. This error is the cause of many of the odorous back whiffs observed from openings intended to act as fresh air inlets.

There is danger in building access or intercepting chambers too close to house walls, and in not cementing them absolutely air-tight. The fact that houses, especially when warmed in autumn and winter, draw or suck in the underground air through walls and basement floors in large volumes, should always be present to the mind of the sanitary engineer. It is often very difficult to convince practical men that this action takes place. There are many other technical defects which are dangerous.

The inspection and cleansing arrangements for the drain outlets are often left unsealed, and are dangerous; therefore, these openings should not be led into manhole chambers but to open air.

The inspection and interception chambers are often unskilfully formed, so that they become very filthy and eventually dangerous. The interception traps are used much too large, and, therefore, are not self-cleansing; ordinary water-flushes pass through and leave a residuum, they choke in time, and the drain fills up with solid filth behind them, so that drains leaking

in any of the joints or through defects in the pipes foul the sub-soil under the basement. Access eyes of open traps and of drains are often placed in position and not rendered air-tight, where the drain-air may be drawn into windows or may pollute food stored in meat safes in areas.

Grease traps of large dimensions are attached to scullery trough wastes and are not cleaned out for months at a time until the grease has decomposed.

Ventilating and soil pipes are fixed of such light material that no proper and safe joints can be made on them; they leak, therefore, at all points, and passing windows the foul air enters the rooms; they are also allowed to discharge at dangerous points. Traps are attached to fittings, such as lavatory basins, baths, troughs, slop sinks, &c., at such distance below the fittings that quite a long length of foul waste pipe is left open between the trap and the fitting, and the air is contaminated. Other traps are so ill arranged, without proper outgo ventilation, that they unseal themselves or are unsealed by other fittings every time they are used. Sometimes one trap is made to do duty for several waste pipes. Nearly always the outgo gratings of basins, baths, and troughs present less area than the waste-pipe, which is, therefore, never fully flushed.

Disconnection of house fittings may be carried too far, every fitting may be trapped off from the drain, and no ventilating shafts provided to clear the drain of foul air. W.C's. with porcelain traps need very great care in connecting with the soil pipes. Frequently these over-floor traps are not connected securely to the soil pipes and allow foul air to pass into the house from the soil pipes.

Clay is still sometimes used for jointing drains, and light rain-water pipes are still used for vent shafts to soil pipes. Dry areas round house-wall foundations are often connected direct to foul drains and sewers, and the traps which might afford partial protection soon run dry, leaving the house in direct connection with the drains and sewers.

Field drains are used to drain the subsoil of houses and round the foundations. Great danger arises from these if they are in any way connected direct to the sewers, as often happens, or if a leakage occurs at any joint or point in a line of house drain, beside which these subsoil field drains are often laid. and so the foul air is drawn for long distances through the field drain into the basements.

In all works of construction the great importance of close attention to apparent trifles is known and acknowledged by engineers; the writer therefore hopes he may be justified in asking the patient attention of the members of this Congress

to the comparatively simple subject of this paper, for it concerns the welfare of the community more than many greater problems, and it is hoped that good practical results may follow a discussion of the subject.

The commendatory words, "modern sanitary arrangements," and "sanitation perfect," commonly inserted in advertisements by agents for the disposal of houses are so frequently untrue or misleading as to constitute a practical danger to the public health. Sanitarians are especially bound to warn and to protect the public against such dangers. We leave a fair margin when we assert that 90 per cent. of the houses daily advertised for disposal are more or less dangerous as residences.

Let us consider this point. Owners wishing to dispose of houses place them upon an agent's books for the purpose; they almost invariably state that the sanitation is perfect: if illness had occurred in the house it is not mentioned. The house agent, an ordinary mortal enough, proceeds, as in duty bound, to dispose of the houses at their highest value without delay. He, being neither architect nor engineer, finds no professional duty incumbent upon him to investigate the sanitary condition of houses, he therefore properly accepts his client's assurances, and retails them to enquirers with possibly a *crescendo* movement. If the agent conveys any doubt, by word or manner, as to the perfect sanitary condition of any house, the enquirer takes prompt alarm and forms a strong opinion that such house must be bad indeed. The house remains on the agent's hands unlet or unsold.

The writer has suggested to house agents the idea of keeping two distinct lists of first and of second-class houses. The first-class list reserved for houses examined, tested, and certified by competent sanitary engineers responsible for their certificates, all other houses being relegated to the second list, for which the agent should accept no responsibility. Experienced house agents regarded the idea as Utopian, and said that they might as well give up their business as attempt to carry out such a scheme.

Standing thus in the forefront of this question is the fact that the house agents are employed by owners solely for the purpose of disposing of their houses, and that in order to ascertain the condition of any house some independent authority must be employed on behalf of the intending purchaser or tenant. It is unreasonable to expect any house agent voluntarily to advise or suggest the employment of expert sanitary surveyors to examine and report on the condition of their houses so long as it remains true that ninety per cent. should be condemned by such examination. This, then, is a practical subject for con-

sideration, and it is necessary to impress the public with the great importance of clearly understanding the nature of the danger.

The sanitary condition of any house may be ascertained, if the owner consents to the investigation, by any qualified engineer, architect, or sanitary surveyor known to possess the necessary special sanitary knowledge, the necessary practical sanitary experience as an expert in house sanitation, and the necessary firmness, truth, and thoroughness of character which are essential to secure an effective sanitary examination. Such an engineer will make a systematic, thorough inspection of any house, he will rigidly test the drains and fittings by the searching methods now known to sanitary experts, and he will give an honest and carefully written report on the facts ascertained and on the sanitary requirements. It is a most important point for every person about taking or buying a house to refuse to sign any document until the full facts concerning the sanitation of the house have been definitely ascertained. After a binding agreement is signed it becomes difficult to secure satisfaction in the event of the arrangements of the drains and fittings proving insanitary. Instances come to our knowledge every week of worry, trouble, and loss thus occasioned by signing agreements in haste and repenting at leisure without means of redress. If it is essential that some agreement shall be signed before the owner will permit the opening of ground necessary for a thorough sanitary examination then the agreement should be framed so that the person to be employed to inspect and certify shall be such a one as described, and his name should be inserted in the agreement; great care should be given to this selection, for under such an agreement the future health of the tenant and his family will depend upon the engineer doing his whole duty. The agreement should bind the proposing tenant only in the event of the house being certified as perfect, or on its being rendered perfect within a stated period, and upon the production of the engineer's written certificate.

Then again, danger often exists in carrying out such works from the want of skill, the careless spirit, and the negligent habits, too often characteristic of artizans—much of this must be attributed to the lack of proper instruction and education, but whatever the cause may be, we find the danger confronting us, which calls for constant vigilance and much experience on the part of the engineer—no doubt the need of proper technical education and practical craft instruction is fairly acknowledged now by thoughtful men, and efforts are being made to supply the deficiency, but many years must elapse before the artizans

themselves will really learn the value of proper trade-craft education, and before the public will gather the harvest from the seed now being sown—here a little and there a little, line upon line, precept upon precept, practice upon practice.

In the plumbing craft there is an awakening to be seen, perhaps for the reason that no craft needed it more, and every encouragement should be given to such efforts after improvement.

An employer who knows his business in theory and practice will appreciate good workmen and employ none other, but he often meets a negligent workman, and with such persons who can deal? Such a man's knowledge of his craft serves only to enable him to scamp his work and hide the knavery; this is one of the greatest of the dangers we have to face in sanitary work.

A competent engineer designs a perfect system of main drainage, or of house sanitation, he selects a competent contractor, but the difficulty of ensuring absolute soundness in the work still exists. Care is now always taken, by those who know their business, to test every part of the work by rigid means; too often these tests reveal defects, and the work has to be done over again. That means, in many cases, the removal of the defective work and the complete renewal of it; but it sometimes means, when work is needed in urgent haste, that no time for such renewal remains, and that the engineer is compelled, much against his own will, to allow the defects to be cut out and the work made sound in some undesirable fashion, *faut de mieux*.

For these reasons cheap work and cheap contractors seldom prove satisfactory. If employers who surround themselves with the best artizans they can train, find difficulty in always securing sound work, how can we expect that unskilled artizans at low wages can ever turn out good work under any circumstances. As a body of practical sanitarians this Institution knows well the anxiety and worry entailed in the supervision of all works where human life is at stake when we are dependent on the care and competence of workmen; there is no branch of the engineering profession requiring closer personal observation of details than that of drainage and house sanitation.

These dangers will only cease, and the prevention of typhoid fever epidemics be secured, when the law with a strong hand will provide for the enforcement of a perfect sanitary system equally upon all—individuals and corporations will never do all that is necessary. If the Legislature will not fulfil this duty the loss of human life will continue and increase every year that the world grows older.

This radical reform could be effected in the most complete way (indeed I see no other way to hope for it) by the appointment of a Minister of Health invested with ample powers to

compel individuals and corporations to do whatever is essential for the health of the community. Scientists and specialists are now sufficiently well agreed on the proper sanitary methods to prevent serious mistakes in sanitation, but power is required for their uniform enforcement. In this age of ceaseless progress in sanitary reform we may well complain of any carelessness or ignorance which still holds back so many responsible persons from intelligently adopting and promptly acting upon the clear answers now authoritatively issued in response to what, a few years ago, were but so many sanitary questions. Questions imply doubts, but we have now definite statements of ascertained sanitary facts established beyond doubt concerning typhoid fever and other diseases. If we act faithfully upon the basis of the knowledge already attained, typhoid fever shall be banished as effectually as we have succeeded in banishing small-pox, so that no case shall occur within the community unless actually imported from some infected district. It is the aim of this Sanitary Institute and of this Sanitary Congress to hasten the arrival of that good time.

On "The Smoke Clauses of the Public Health Act, 1875," *by* HUBERT L. TERRY, F.I.C.

THE state of the atmosphere in our large cities is a subject that is fraught with interest to the sanitary reformers of this country, consequently I have little hesitation in bringing forward the smoke question, although I am not sanguine that the views I hold will commend themselves to the majority of my hearers. It seems to be generally agreed that smoke is a nuisance, and that black smoke in particular is the incarnation of evil. Now, from a hygienic point of view, I do not feel at all sure that the case against black smoke has been made out. The legislature certainly concerns itself only with black smoke as evolved from factories and workshops, but there is a growing conviction amongst those who have gone into the matter that the grey smoke, of the household grate, is really a more deleterious product. Without going deep into the chemistry of the subject, it may be stated that while the high temperature of the boiler fire causes the hydro-carbons of the

coal to dissociate producing hydrogen and free carbon, the lower temperature prevailing in the household grate, especially where the fire is made up to last a long time, produces a smoke consisting largely of oily hydro-carbons. These latter are naturally more injurious to organisms than is free carbon, which is recognised as a most powerful deodorant and disinfectant; in fact it is quite probable that black smoke plays an important part in the economy of town life in this respect. Apart, however, from its blackness, all smoke contains sulphurous acid, and it is to this body that the destructive action of town smoke on vegetation is really due. Considering the present state of our knowledge on the subject, the legislature very wisely omits any reference to this sulphurous acid, the agent which has destroyed the vegetation in such large districts in Lancashire and Southern Spain. Figures have frequently been given by writers on the smoke question shewing the amount of oil of vitriol poured into the air of our isles from burning coal. The yearly production of coal in the United Kingdom, allowing for exports and gas-making, would on the basis of 1 per cent. of sulphur, a low estimate, on combustion yield over 4,000,000 tons of sulphuric acid. Although such figures are liable to give the general reader an exaggerated idea of the evil owing to the extreme dilution in which most of this acid is formed, yet they serve to show that the evil is of some magnitude. I have gone into these details about smoke to show that any legislation which only deals with black smoke can have but very small results. And now for the point I wish to draw special attention to. Supposing for the sake of argument that black smoke is a great evil and worthy of suppression by Urban and Sanitary Authorities, I submit that these latter should be careful how in their zeal to purify the atmosphere they so harass manufacturers in their localities as to cause them to take wings and fly away to countries where such restrictions are not enforced. To take the case of chemical manufacturers, a class of men who are generally credited by the public as the source of all atmospheric pollution in the vicinity of their works. Without going into details as to names or places, I may say that the authorities of a certain town have recently seen fit to institute proceedings against various chemical manufacturers under the Smoke Clauses of the Public Health Act, 1875. In their defence the chemical manufacturers claim exemption under the saving clause which reads as follows. . . . . "The Court shall hold that no nuisance is created within the meaning of this Act, if it is satisfied that such fire-place or furnace is constructed in such manner as to consume as far as practicable, having regard to the nature of the manufacture or trade, all smoke

arising therefrom, and that such fire-place or furnace has been carefully attended to by the person having charge thereof."

They feel assured that it was for such cases as theirs that the legislature admitted the saving clause. This, however, has been ruled against them on appeal. Now to my mind this clause would apply specially to chemical works where operations involving intermittent firing, the gradual heating-up of retorts and kilns, &c., &c., are necessarily productive of black smoke. It is one thing to fire a boiler for the supply of steam to a steady running engine, and another to fire it when steam is required for chemical purposes, and when the boiler pressure may fall 20 pounds in a minute or two. It would therefore seem that cotton mills and chemical works should not be classed in the same category. Supposing, however, that the spirit of the saving clause were admitted as being applicable to chemical works, this would necessitate the supplanting of the smoke inspector as found at the present time by a chemical engineer, or other person competent to express an opinion on the terms, "as far as is practicable," or "having regard to the nature of the process." The inspector of to-day is certainly not so qualified, and some dissatisfaction has been expressed by manufacturers who have come under his notice, as in such cases as the colour of smoke "personal error," is an important factor. In the case of a smoke prosecution, attention should be paid to the state of the weather. Were I an inspector and had a grudge against a certain chimney—I do not for one moment suggest that such cases really occur—I know what sort of a day I should choose for my inspection. The state of the weather will no doubt be considered by the qualified inspector of the future. In the foregoing I do not wish to be understood as approving at all of the emission of black smoke where such can be easily prevented. The smoke problem, as the direct cause of the injurious fogs in London, is one worthy the attention of our foremost scientific men, although contributions to the literature of the subject from the pens of practical men should be invited. The recent reference to the matter in the House of Lords, the trial of anthracite for house purposes, and the trials of smoke consuming appliances by Mr. A. E. Fletcher's committee, are all indications of the attention the subject is receiving. Smoke consuming appliances arise like the flies in summer, but the appliance is not yet on the market that will prevent a careless fireman from making smoke. To conclude, our local authorities —presuming that the prosecutions are instituted entirely from a Benthamite point of view—should be lenient in respect to chemical and allied works, especially when these form the means of livelihood to the working classes in their vicinity. We must

not forget that our large towns in many cases owe their pre-eminence to their manufactures, and it would be impolitic to impose vexatious restrictions, especially when the benefit to be obtained is so problematical. No doubt it would be much pleasanter if our town atmospheres could equal the air of Grindelwald, but it is more than possible that we may have to decide between commercial supremacy and salubrity. Can we support our increasing population on pure air?

Without moving any formal resolution, I would submit that—

(1.) Local authorities should acknowledge the special applicability of the saving clause to section 91, sub-section 7, Public Health Act 1875, to chemical works.

(2.) That where the smoke clauses are enforced the inspector should be a chemical engineer or other person competent to carry out the spirit of the Act.

Dr. W. G. Black (Edinburgh) expressed the hope that the discussion would be extended to greater length than the paper, for the subject was one he regarded as of the greatest importance. The greatest sinners were the law makers themselves, who thus became the law breakers. Out of the chimney of the humble working man's cottage one might see thin blue smoke curling, but let them only go to the large manufactory in the neighbourhood, and from it came a large column of dense black smoke as from the summit of Vesuvius; striking anomalies like these ought to be mitigated by reasonable supervision. Staying at the marine and residential town of Scarborough he had once noticed dense columns of smoke issuing from the chimneys of the large hotels there, hotels which had been built on scientific principles for the use of health resorters. From the windows of the Queen's Hotel at Manchester his attention had also been particularly called to the density of the smoke issuing from the chimney of the Royal Infirmary, which was presumed to be under scientific management. The nuisance was so great to the streets that he communicated with the Medical Officer of Health there. The other day in Edinburgh he had especially noticed the dense smoke which issued from the newly and expensively built University Building, and from the "George Watson" School, polluting the atmosphere of the neighbourhood. In these two cases also he reported the nuisance to the Medical Officer of Health for Edinburgh. The evil in many cases arose from the inferiority of the fuel used, the want of smoke-consuming grates, and in the absence of efficient supervision of the lighting and management of the furnaces.

Mr. J. Oldfield (London) said the paper had been a most interesting one from many points of view, and one for which they must all thank the reader. The question of smoke was, he contended, distinctly

one of degree. With regard to black smoke he felt that the blackness was not seriously the great cause of the fault, and the removal of the blackness would not remove the fault. That the carbon contained in black smoke was essentially injurious was proved by the fact that it affected the lungs of men who had to endure it, such as sweeps, colliers, &c., and when they remembered what serious injury had been caused in the North country by hydrochloric acid diffused by smoke, and how it had been removed by legislation to the ultimate benefit, even of the manufacturers, it was sufficient answer to the difficulty raised by the reader of the paper that legislation must not harass the manufacturers. The great thing they had to look at was the health of the community, and if necessary we must harass the manufacturers and send them from one place to another until they find a way to utilise these waste products that they sent out into the air and bring them to some useful purpose, as was done with the hydrochloric acid, owing to the legislation. It was done in the case of hydrochloric acid, and it could be done with smoke. If the legislature prevented them discharging the black smoke, then ingenuity would soon set to work to utilise this waste product in some useful manner. Near Ealing his attention had been called to a smoke pollution in the air arising from brick-fields, the air was absolutely pure in appearance but to breathe it caused a deathly feeling, and therefore he said the blackness of smoke was not the essential evil. It was, as he said at first, a question of degree, and when they had discovered the limit beyond which it was harmful to the community, then pollutions beyond that limit must be prevented.

Dr. J. Groves (Carisbroke) said he hoped to get some light in reference to a smoke poisoning which had harassed him for some years. It was a nuisance arising from cement works, and if anyone could help him to a solution of this nuisance it would be a great help to him and many other people, and would relieve a very great lady of what had been an annoyance to her at various periods. The sanitary authority of the locality were unable to do anything, and Local Government Board Inspectors under the Alkali Acts said they were doing all they could. So objectionable was the pollution that when the wind was blowing from the works the inhabitants had to close their windows a mile off. There was no black smoke but a smell, like the smell from brick-works—something very irritating—which caused people to cough a mile off and to sneeze. The smoke had been analysed again and again, but the most they could arrive at was that there was a certain amount of chlorine in it, though not sufficient to produce the effects of which he had spoken. It seemed curious indeed that in this advanced age they could not get that gross nuisance stopped.

The President of the Section (Mr. James Lemon) said that some years ago the cement works at Southampton were a very great nuisance indeed. He was one of the deputation which travelled through

England to get information about it, and they harassed the manufacturers until they at last induced them to do something, and the result was, that at Southampton they had no longer any nuisance from these works. They had a kind of cremator at the cement works and the fumes passing over this were practically consumed. During the last few years they had had no complaint to make of any annoyance or nuisance from these cement works.

Mr. H. L. Terry (Manchester), replying to various suggestions which had been made, said that at Manchester, as had been mentioned, the hotels and Infirmary were a source of nuisance, and they escaped without punishment. If a manufacturer had created as much nuisance for three minutes in the hour he would have been fined £5, and he contended that what was wanted was, that the law should be administered equally in all cases. There ought also to be a proper inspector to decide if the nuisance could be prevented. Wherever black smoke could be prevented it must be done, but with regard to utilising the waste products of smoke, he did not think they could see any way to do that at present. He had had no personal experience of the fumes from cement works, but he had been told they were strongly fertilising in their properties.

On "Drain and Soil-pipe Ventilation"—(with a suggestion)—by H. R. Kenwood, M.B., D.P.H., F.C.S.

I feel that it is unnecessary for me to insist upon the importance of this subject; indeed, it is admitted in the attempt now generally made to bring about a satisfactory Drain and Soil-pipe Ventilation; nor is it necessary to dilate upon the fact that danger results from inefficiency—danger, that is, against which it is our duty and our province to cope!

The Model Bye-laws enact, as you will remember, that for efficient ventilation it is essential to provide at least two untrapped openings in the drains. These openings are required to be respectively as near the upper and lower extremities of the drain as practicable. Paragraphs (a) and (b), section 65, of the Bye-laws, with respect to new streets and buildings, prescribe that one of the two requisite openings is to be at or near the ground level, and is to consist of a suitable pipe or shaft, or a disconnecting

chamber or manhole, placed as near as practicable to, but on the house side of the trap; and the second opening is to be by a vertical pipe or shaft (which may be the soil-pipe) carried up as far distant from the other opening as practicable, to a height of at least 10 ft., but so as to avoid risk of discharging drain air into any building. Such provision is made, of course, so as to procure a current of fresh air through the entire length of house drain (and soil pipe where such exists), and thus to exclude the possibility of the entrance of drain air, as such, into the house.

Now what are the conditions which may be held to insure that air will enter an opening in the base of a pipe say 40 feet high and escape at its upper end? There is no natural law with which I am acquainted which will insure this, and some provision must be made to rarefy the air in the pipe, and thus considerably diminish its pressure: as by warming it and causing it to expand.

With regard to the aspirating effect of the wind blowing over the top of a 4-inch ventilator, with its outlet protected by a small wire cap, its action must be at any time very small indeed, and its effect is probably not felt very low down the pipe; and cowls do not add to this effect. Moreover, the only factors which need seriously concern us in such an important matter as drain and soil-pipe ventilation, are those upon which we may count upon, and the wind not only "bloweth *where* it listeth," but also *when* it listeth.

The most recent and improved method is, as you are aware, to carry up the fresh air inlet to the drain and soil-pipe a few feet above the ground level, and to guard the opening by a talc valve flap; and it is the examination into the efficiency of such provisions that I have more especially concerned myself, for it represents the most recent and advanced sanitation in respect of this subject, and it is the one which is now confidently recommended, and which is becoming generally adopted.

My tests, then, have been especially directed to those houses in which the best provisions for such ventilation obtain!

The talc valve affords a capital means of ascertaining when an incurrent or otherwise is taking place, and in those cases where it is lightly hung, kept clean, and has perfect freedom to move within the valve-box, it is a delicate indicator of such currents. When there are none of these upon the inlet, I have had, of course, to resort to the test of the smoke from smouldering brown paper, or to note the effect produced upon small captive hydrogen balloons. I have examined 100 of these valve-guarded inlets in the front gardens or areas of houses, chiefly in the district of Chelsea.

At the commencement of my investigations I found pretty generally that the valve opened and shut intermittently, and that the extent to which it opened also varied, and I naturally asked myself the question, why this intermittency, and why this difference in degree of the air-current? It was obvious that if in the soil-pipe itself conditions obtained which were sufficient to cause the air to ascend it, such air must enter the inlet by virtue of a "vis-a-fronte" or aspirating effect. Why then should this aspirating effect vary every moment as it does in its intensity, and become a negative quantity with almost equal frequency? There is no altering condition of the soil-pipe and drain, except when a water-closet is being used for any purpose, and how often is this? certainly for not much more than twenty minutes altogether in every day!

It was not, therefore, difficult to see that if there was anything to induce soil-pipe ventilation at all within the drain and soil-pipe, that something must be a constant factor upon which we could reckon, except for, say 20 minutes every day, when it was disturbed; and that the valve should be ALWAYS opened, if not always motionless. The true cause of the intermittent and varying extent of movement in the valves, was clearly demonstrated to be due to external air currents (arising from external causes) which impinge on the valve, and not to any causes acting within the drain and soil-pipes themselves; and the effect of such external air currents in drain and soil-pipe ventilation must be practically nil, and cannot do much more than effect a movement of the valve. Valves which many would call "acting" were seen not to act when external influences were shut off as completely as possible by a card-board box, arranged so as to admit of plenty of air to meet any aspiration (suction) requirements, but so as to prevent the impact of an external and independent air current. And in this connection I would point out that it is not sufficient if the wind is blowing—say down a street—to guard the opening from the wind solely in the direction from which it blows, for, of course, it is deflected by steps, porches, etc., the current breaks up and eddies, and approaches the valve-box from almost any direction.

On several occasions I had the top sashes of the windows pulled down, and the inlets being close to, and on about the same level as the part of the window opened, the movements of the blind and those of the talc valve could be compared, and these were always found to be perfectly synchronous and to correspond in degree; and this again clearly demonstrates the true cause of the valve movements in the majority of cases.

To further convince myself however of the fact that external

and independent air-currents were responsible for the movements of the valve in the great majority of cases, I then procured a detached valve-box and placed it alongside that attached to the drain inlet, and found that the movements in the two cases absolutely synchronized with each other. Lastly, gentlemen, where on the same day different valves have been working—I prefer to put it that way—in different degrees, I have frequently found a solution to the conundrum by finding that some are more protected from external air-currents by steps, etc., than others.

I would also warn you that, in conducting such investigations, the fact that a valve is seen to be open must *not* be taken as conclusive evidence of its "working." There are tricksters in every trade, and I have met with some cases where the valve boxes and valves are so fixed and fashioned, that the valve hanging plumb never closes the inlet, except when a back current is taking place, and sometimes not even then.

Drain and soil-pipe ventilation to be *thoroughly* efficient *should* be constant!—I think no sound sanitarian will dispute that fact—far less do I fear dissent when I contend that an air-inlet when provided should take *in* air and not send it *out*. I am convinced, from many carefully applied tests, that it is comparatively seldom that an air-current is induced to ascend the soil-pipe and ventilator; and in every case, where there is anything at all taking place, the current is of an extremely ephemeral nature, and is apt at short intervals to take a diametrically opposite course, to descend the soil-pipe and drain and to escape at the point at which the merest tyro in physics could tell that it should enter, if anything at all is taking place. This, however, would not be claimed to be of much importance where valves are provided (and hence the value of this addition) save that it shows that the principle is defective.

But what shall we say of those cases—numerous as they are—where the inlet is not guarded, and foul air escapes near sitting-rooms and pantrys to enter by the open windows? Here is a real source of danger! and to accentuate this fact I may point out, that once while examining such unprotected *inlets*, the back currents of air which frequently escaped here occasioned in me an acute attack of diarrhœa.

To further convince you of the occurrence of these down currents, I might add that in one or two cases I have placed a smoke-rocket well down inside the inlet pipe for fresh air, and noticed almost the whole of the smoke emerge from the inlet opening. In two cases which I had entered in my book as "acting intermittently," when I came to apply this smoke-rocket test I was able to get close to the exit opening (about

40 feet high), and not only in these two instances did I not detect the *slightest escape of smoke*, but on applying my nose close over the opening I could not even smell the faintest trace of it. Meanwhile a friend had been noting the escape of the *whole* of the smoke in heavy clouds, issuing in puffs *from the inlet.*

If there is any natural law, which might be expected to induce the air to constantly enter at the so-called inlet, by what controversion of that law can it be imagined that air shall escape, to almost the same degree as it enters, from the same opening? If this is the case—and I can show that it is—the fact reflects very seriously upon the efficiency of our latest provisions for drain and soil-pipe ventilation! One cannot watch one of these talc valves for two consecutive minutes, without noting that it is suddenly applied, under a slight pressure, against the window (or a cast shoulder in the face-plate) of the valve-box, and if the valve is *then* lifted, smoke is blown away from the inlet, and one's face commonly acquires a deposit of fine dust, and one's nose is assailed by odours which would not have been courted.

You will naturally be curious to hear, and you have the right to demand, some further information concerning the conditions under which I have tested such inlets. You will not consider that I have acted unfairly in selecting days upon which air movement was not too active, although on every occasion there has been a distinct though light breeze blowing; the shade temperature has varied upon the different days on which I have worked from 56 to 73, the Barometric pressure from 29·84 to 30·25. I have kept a list of the houses, the days upon which they were examined, together with the above-mentioned atmospheric conditions existing on these days, and the results of the 100 tests applied have been entered under three headings, *i.e.*—

(1.) "Not acting." These formed 58°/ₒ.

(2.) "Valve only very occasionally opened." These formed 23°/ₒ.

(3.) "Intermittently opened and shut with about equal frequency." These instances formed 19°/ₒ.

It must be understood that these results apply to inlets from which all external air currents have been shut off, and, in all alike, there were evidences of frequent back currents when the valves were removed, and the smoke test, and that of captive hydrogen balloons, were employed.

I have also noted the height (as judged by the number of stories of each house), and the course and point of termination of the soil-pipe and ventilator. I find that, very contrary to one's expectations, where talc valves are applied to the inlet, that the

movements of these do not appear to be influenced either by the height of the exit opening (I have not examined houses of more than four stories—*i.e.*, about 50 feet high), or by the number and nature of the bends in such pipes. Most of these have been carried up straight above the eaves, but in one remarkable instance—remarkable inasmuch as it was one of a very few instances in which I found any tendency to an aspiration effect induced—there were two rectangular bends, which are sufficient in themselves, by the resistance they offer to the flow of air to diminish the velocity of any current to one quarter the original! Sub-section 4, Section 65, of the Model Bye-laws with respect to New Streets and Buildings has been framed with an eye to this fact, though it would appear, on the evidence of this test to be of no great import, it runs as follows:—"no bend or angle shall (except where unavoidable) be formed in any pipe or shaft used in connection with either of the arrangements specified." In spite, however, of the great resistance offered, and *judging by the valve*, the inlet was acting with greater force than a neighbouring one in the same street which had the additional advantage of a straight soil-pipe and ventilator. One is acquainted with the fact that the unexpected is apt to happen with great persistency in this world, but when we find soil-pipe ventilation subverting all the laws of physics, it is logical to attack either the one or the other as being at fault. Gentlemen, it is the soil-pipe ventilation!

An idea which has occurred to me is so simple that I can lay no claims to ingenuity, indeed the principles of its application are so widely in vogue for other and different purposes, that I do not claim to have exercised any originality, and when I came to consider if there were any means of remedying the present unsatisfactory condition of drain and soil-pipe ventilation, it occurred to me so *spontaneously* that I could not believe for some time that it had not been already suggested—if not practised. I have failed however, strange to say, in finding any reference to it whatever!

I have always been struck with the persistence with which the bath room—and nowadays such is growing to be considered almost a necessity in every house—insists upon adjoining the water closet; why not therefore, where this is the case, take advantage of the hot-water circulation system to create the up-draught in the soil-pipe, which of course runs up the wall immediately outside the water closet? It occurred to me that all which was necessary was to connect a length of piping with the hot-water circulation system, it would only involve the removal of a brick in order to take this piping through the wall, two coils could then be conducted round the soil-pipe

and ventilator, and the piping then returned into the hot-water circulation system again. The advantage to be gained by taking off this loop from the highest point to which the hot-water circulation system reaches is too obvious to need anything but mention!

Before the plan was put in operation I had some misgivings as to whether the increased resistance by friction which would thereby be offered to the flow of water, would affect its circulation, and accordingly I recommended that the curves should be made gradually spiral, rather than horizontal, so as to diminish friction. I also doubted whether the fact of thus conducting the hot water outside the house would affect the supply of hot water to the bath. Both these misgivings I find—a friend having kindly put the plan in operation—have not been justified!

The only other point which it occurs to me can be raised is, as to whether the part exposed may not be affected by frosts in the winter—of this I am assured by competent authorities, that if such exposed piping is incased in felt and boarded in, there is absolutely no risk whatever—no matter how severe the weather.

I must next speak of its efficiency! In the first place I would again adduce two points which we should aim at achieving, viz., that drain and soil-pipe ventilation should be made constant—and there can be no doubt that if this plan induces a current at all it must of necessity be a constant one—and also that the danger of the inlet allowing vitiated air to escape, where no valves are applied, must be guarded against. I would remind you that the hot water circulation is in action, as a rule, whenever the kitchen fire is alight, which in the majority of houses (especially in this age of late dinners) is all day long and late through the evening, through summer and winter alike; and that even through the night the pipes remain charged with warm water. Under ordinary circumstances no advantage is taken of this hot water circulation, save when the bath is used; but that when such a plan as I have indicated is adopted, it is always effecting some good in subserving drain and soil-pipe ventilation.

Does the plan ensure a constant entrance of fresh air into the inlet, and altogether do away with down drafts? I am in a position to say that in the case in which it has been applied that most assuredly it does, and that its effect has been uniformly satisfactory when tested under varying conditions of the atmosphere; that the opening of the ground level thus becomes invariably an inlet; and that the draft created is sufficient to draw in the smoke of burning paper from a distance of 6 inches from the opening, when the external atmosphere is quiescent and external air-currents are provided against.

If then the plan is efficient—and it appears to be so—it will provide a comparatively costless and a very simple means of effecting a greatly improved drain and soil-pipe ventilation, which will be welcome to those of us who consider that if such ventilation is a necessity at all, it should also be a necessity to effect it with the greatest possible degree of efficiency!

Dr. J. Groves (Carisbroke) said that people too often lost sight of the fact that there was a natural law which controlled ventilation everywhere—the law of the diffusion of gases. If Engineers would only keep this law always in view there would not be so many lamentable and ridiculous failures. Of course, if they made the air in the soil-pipe warmer than the sewer air the air would pass up, but if the air in the sewer was warmer than they made the air in the soil-pipe it would go down.

Mr. J. H. Ball (Portsmouth) said this matter was one in which even those of them who had been the least time at work had had some experience. Quite recently he came across an instance of the value of inlet ventilation at the foot of the soil-pipe. He had examined two adjacent ventilating-pipes, one of which smelt very bad, while the other was quite sweet. On examination he found that the air inlet near the foot of the one which was offensive had been closed, while in the other the current of air kept passing at all times, and the soil-pipe was free from smell. One more difficulty in the way of getting ventilation in house-drains as distinct from sewers was that the local authorities were so dreadfully handicapped in their insistance upon the right system, and the inspection of that system when it had been carried out. He thought it would be a matter of the greatest public service if they could get some one of undoubted experience to insist upon the advisability of bodies who had the health of a district entrusted to them having powers to see that proper sanitary arrangements in this respect were carried out in every house.

Mr. W. H. Axford, M.B. (Southsea), speaking as a medical man, said he regarded it as the duty of the profession to which he belonged to prevent rather than to cure disease. The difficulties they met with from obstinacy and ignorance were wonderful, and in this matter of insanitary arrangements in houses, as matters now stood they could only do away with the nuisance after the evil was done. He had come to the conclusion that house drainage ought to be done by the local authority, and not left to the owner or builder of the house. The authority should do the work and charge the cost to the owner. They had in Portsmouth a most elaborate system of drainage, satis-

factory in the extreme, but the house connections were in many cases not so satisfactory as they ought to be. The difficulty was that people did not know how to do it, or would not go to the expense. Therefore he contended that the authority should do the work as it ought to be done, and charge it to the owner. That, he felt, would be the only way to insure a lower death-rate from infectious diseases.

Mr. Tom Nanson (London) said it is always well to strive after the ideal, but often there is a great distance betwixt the ideal and what is actually efficient. The ideal of drain ventilation is the passage of a constant current of fresh air through the drain. The scheme foreshadowed by the reader of the paper was not an impossible one, and should the necessities of a case require it he would be one of the first to adopt it. He thought that efficient ventilation could be obtained by fixing the ventilating-pipe on a wall having a south-east, south, or west aspect, so that it might be warmed by the sun in hot weather, and the ordinary current increased when putrefaction was most rapid; this would keep the house-drain sweet without going to the expense of Dr. Kenwood's scheme.

Mr. William Challoner (Blackpool) said that it had fallen to his lot to be one of the much abused individuals, a plumber, and Dr. Kenwood's paper dealt with that portion of sanitary work with which plumbers were most intimately concerned. The town of Blackpool, from which he came, was in an especially favoured position in this respect, for they had a sanitary inspector and staff of men who had nothing to do but inspect drains, on the house-to-house principle. He was rather afraid that the cure suggested by Dr. Kenwood would not act well in practice. There would be a difficulty in keeping the water at a sufficient heat, with an ordinary bath supply, to be of any avail when placed round the soil-pipe, and he did not think that one could be quite sure of preventing its freezing in winter unless it was covered with felting or some similar protection. He was also rather inclined to think, as Dr. Groves had suggested, the order of ventilation might at times be reversed. With regard to mica flaps, as the reader of the paper had said, he had found them break easily, and they required constant attention, which domestic servants did not give to them. One of the principal causes of their breakage was the pressure of air in the inlet-pipe, when the closet, probably a couple of stories higher, was discharged into the soil-pipe. The prevention of all the evils Dr. Kenwood describes can be effected without any of these contrivances; in a system of house-drains effectually trapped from the main sewer and the inside of the house, but open from inlet to outlet, if the inlet was carried up above the eaves and the outlet a little higher up the chimney stack, if convenient, and if not up the roof to the ridge, then the constant displacement of air in the soil-pipe and drains by the discharge of closet, bath, sink, and rain-water gullies would of itself, by natural means, prevent any danger or nuisance arising from stagnation of air in the drains, and any emanations

that might arise would be delivered by either the intended inlet or outlet, and in either case high enough in the air to be practically harmless.

Mr. G. J. Symons, F.R.S. (London), said that the real question was that of the specific gravity of the two liquids. Cold air descended while warm went up, and in that they had the real explanation. With regard to this question of ventilation he desired to direct attention to the clear and able article by Mr. W. N. Shaw, F.R.S., on "Warming and Ventilation" in the "Treatise on Hygiene," which had just been issued by Mr. Shirley Murphy and Dr. Stevenson.

Mr. W. J. Fletcher, F.R.I.B.A. (Wimborne), said there was nothing in sanitary arrangements more important than the question they were now discussing. It was no use having house drainage carefully designed and executed unless the drains were ventilated properly, and he hoped nothing that had been said would prevent people maintaining the system at present laid down in the Model Bye-laws of having the two untrapped openings in every system of house drainage until something better was found out.

The President of the Section (Mr. James Lemon, F.R.I.B.A.) said he looked upon the ventilation of drains in the light of a safety valve, and he should be very sorry if any discussion they had should make the general public lose confidence in the ventilation which already existed. Though the system now adopted was inefficient, he should be very sorry to see the day come when the ventilation should be given up, for in some form it was essential. They might criticise more or less the model Bye-laws issued by the Local Government Board, but let them consider the conditions of towns which had no Bye-laws at all! A case had recently been brought to his notice in which it took about five years to get Bye-laws passed for a town, and the only remedy he could suggest to avoid such difficulties was that a Building Act should be passed to do away with Bye-laws altogether. They had a Building Act for the Metropolis, and he did not see why they should not have one for the whole of the country. Local surroundings could be dealt with by the local authority, but the strength of a wall was the same, and the laws of gases were the same all over the kingdom. And there would moreover be this advantage about it; there would be a certain amount of appeals, and the decisions which were given would be of use in guiding the community at large, the one law governing them all. The sooner they got legislation of that kind the better it would be for all the country.

Mr. H. R. Kenwood, M.B. (London), in replying to the discussion, said the question had been raised as to whether the suggestion which he had made would be satisfactory in practice; well, it had been put into practice and was found to work most efficiently. He was

assured, in the case where it had been tried, that the provision was sufficient to create a continuous indraught; but he regretted the fact that hitherto he had not, himself, had the opportunity of witnessing the plan in operation. With regard to the accusation made that the aim of a constant up-current was too idealistic, he urged that they must go for ideals or they would cease to make progress. In aiming at an ideal the result was never more than an improvement in the original state of things; the ideal itself was never reached. He did not consider that any suggestion likely to effect good should be considered too idealistic when it had reference to the Public Health. As to the question of aspect, he thought it was going rather too far to suggest that aspect alone would insure a sufficient difference in the temperature all the year round, to effect much in the matter of drain and soil-pipe ventilation, though it was doubtless a factor which should be taken advantage of whenever possible, when planning the sanitary provisions of a house. He could assure the gentleman who feared the effects of frost that it would be found practicable to guard against this danger in the manner he had indicated in the Paper, *i.e.*, by the use of felt and a wooden casing. With regard to Drs. Stevenson and Murphy's "Treatise on Hygiene," mentioned by Mr. Symons, it could be read with the greatest advantage by all; and Prof. Shaw had contributed a most able article upon "Warming and Ventilation," in which the physics of the subject were treated of most exhaustively, and from which much valuable information might be gleaned. In conclusion he thanked those present for the kindly interest with which they had received the paper.

On "*The Pollution of Rivers and Canals by Manufacturing and Industrial operations: with special reference to recent processes for the prevention of such pollution*," by W. HEPWORTH COLLINS, F.C.S., F.G.S., F.R.M.S., &c., &c.

THE recent action of many of our County Councils and Sanitary Authorities, together with trading-concerns and riparian owners possessing pecuniary interests in the preservation of water-rights and river and canal carriage, has undoubtedly wrought much good, and served a most useful purpose in calling public attention to the alleged danger to public health arising from the grave pollution of rivers and canals by matter other than sewage.

In speaking of this pollution, I purpose dividing the term "pollution" into two separate and distinct parts:—1st. The

pollution by manufacturing and industrial operations; and 2nd. The pollution by town's sewage; but I only purpose dealing with and considering the former of these in this paper.

"The difficult problem," as my late friend Dr. Angus Smith described the river pollution by manufacturing refuse question, would now appear to be no longer difficult; and it is a subject for more than surprise at the absolute apathy displayed by many of the local authorities, constituted to deal with the matter, in exercising the powers conferred upon them under the Local Government Board Acts, and the Rivers Pollution Prevention Acts.

The importance of the question cannot be over estimated, and this is evidenced by the fact that nearly every volume of the Transactions of this Institute contains valuable contributions on the subject by many of our most eminent sanitarians and chemists.

The extent also to which the matter has engaged the attention of the inventive mind is exhibited by the Official Journal of the Patent Office, which, at the same time, indicates the character of the outside attention which has been applied in endeavouring to secure the desired end by simple and economical means; and to effect this in such a manner as to thoroughly prevent any complaint or objection, at present in most cases only too well founded, of effluvium nuisance arising therefrom, and a consequent danger to public health thus created.

It is, somewhat unfortunately perhaps, a common practice when speaking of sewage to include in such a term the waste waters from manufacturing operations, which in many cases pass directly into the sewers, although we can hardly look upon sewage as composed solely of human excrement diluted with water, but as water polluted with a variety of other matters of an organic character in suspension and solution in varying quantities.

The refuse or waste waters from many of our manufacturing and industrial processes are passed, in multitudes of cases, direct into the sewers, with obviously dangerous results, which we shall consider later. In the case of large works, generally situated on or near a stream or canal, the river or water from other sources made use of in the works is afterwards passed directly into the river again but in a highly polluted condition through its admixture with the special matters made use of in the several technical processes carried on in such works.

These effluent waters, in most cases highly polluted with mineral and organic matter of a poisonous or dangerous nature, are then permitted to pass into the nearest watercourse and thus brought into intimate admixture with the sewage and

organic matter contained in such stream and the adjacent river, and more or less chemical action is thus immediately set up.

The foulness of the river is thus increased as it flows along, and time, together with other peculiar facilities, is thus afforded to enable chemical reaction and decomposition of the complex organic matters contained in both sewage and manufacturing-refuse to progress.

These matters thus acting and re-acting on each other render the water not only most offensive to the sense, but also a prolific source of injury to health by its abundant nauseous gaseous emanations.

There can be no doubt that our rivers and streams in this state are absolutely injurious to health, and in a condition to readily encourage, foster, and propagate a typhoid or similar malignant outbreak.

In spite of the "Rivers Pollution Prevention Acts," of the enormous amount of money, public and otherwise, expended on works for the mitigation of river-pollution, and in litigation connected therewith, it is most unfortunately the case that the rivers and canals are, in general terms, more polluted and in a worse state of filthiness than they used to be, although they are probably less polluted by sewage matter in its gross condition. As an instance in point, the following results of my analyses show the state of the Irwell at Manchester in 1882, and during the present year:—

TABLE I.

Sample Marked.	May, 1882.	May, 1892.
1. Total Solids	122·93	160·64
2. Total Organic Matter	23·43	59·64
3. Total Mineral Salts	99·50	101·00
4. Total Solids in Suspension	17·26	29·63
5. Ammonia	0·963	0·960
6. Chlorine	6·390	11·946
7. Oxygen absorbed in one hour	2·900	4·900

In the case of an "industrial river," the clear bright water rising from the hillside comes to the first manufacturer who has works on the stream, and he takes for his purposes, whatever they may be, that which the people in the towns would be glad of for domestic use. If used simply for power, it leaves his works without receiving any injury; but because it is pure and clean it is immediately taken up by the dyer, calico-printer, bleacher, paper-maker, woollen manufacturer and dyer, each of whom requires such water. After they have done with it they

pass it from their works in a more or less highly polluted condition, as the following results of my analyses indicate :—

TABLE II.—*Effluent from Paper Manufacturing.*

Sample Marked.	Water before use.	Effluent No. 1 Mill	Effluent No. 2 Mill.	Effluent No. 3 Mill.
1. Total Solid Matter	10·6	815·73	1074·30	1445·53
2. Total Organic Matter	2·3	56·23	69·00	106·53
3. Total Mineral Matter	6·7	109·50	100·00	97·00
4. Total Solids in Suspension.	1·6	650·00	905·30	1240·00
5. Temporary Hardness	0·55	1·96	4·67	5·00
6. Permanent Hardness	4·50	11·00	12·90	13·63
7. Total Hardness	5·05	12·96	17·57	18·63

TABLE III.—*Strong Alkaline Effluent from Paper Works.*

Sample Marked.	Effluent from Straw Boiler.	Effluent from Esparto Boiler.	Effluent Wood Pulp.
1. Total Solids and Alkali	5·9	6·2	5·0
2. Total Organic Matter	7·3	9·0	6·2
3. Water	86·8	84·8	88·8

TABLE IV.—*Effluent from Bleach Works.*

Sample marked.	Water before use.	No. 1 Works Effluent.	No. 2 Works Effluent.
1. Total Solid Matter	16·1	1351·62	1491·30
2. Total Organic Matter	2·6	46·32	41·00
3. Total Mineral Matter	11·5	605·30	500·00
4. Total Solids in Suspension.........	2·0	700·00	950·30
5. Temporary Hardness	1·1	12·30	16·20
6. Permanent Hardness	5·3	21·00	25·30
7. Total Hardness	6·4	33·30	41·50

TABLE V.—*Effluent from Dye Works.*

Sample marked.	Water before use.	No. 1 Works Effluent.	No. 2 Works Effluent.
1. Total Solid Matter	21·12	378·60	368·40
2. Total Organic Matter	3·92	29·60	32·00
3. Total Mineral Matter	14·20	149·00	120·40
4. Total Solids in Suspension.........	3·00	200·00	216·00
5. Temporary Hardness	1·40	6·2	7·3
6. Permanent Hardness	5·50	10·9	15·0
7. Total Hardness	6·90	17·1	22·3

TABLE VI.—*Effluent from Calico Printing Works.*

Sample marked.	Water before use.	No. 1 Works Effluent.	No. 2 Works Effluent.
1. Total Solid Matter	20·50	385·13	306·70
2. Total Organic Matter	6·20	39·60	30·20
3. Total Mineral Matter	10·30	139·53	120·00
4. Total Solids in Suspension	4·00	206·00	156·50
5. Temporary Hardness	0 90	11·50	12·63
6. Permanent Hardness	3·65	17·00	19·00
7. Total Hardness	4·55	28·50	31·63

To all these industries, and others besides, pure *clean* water is a necessity, and it must be got from the spring, river, or well; or if from other sources it must undergo certain filtering and cleansing processes before being fit for use in any of the industries referred to. It is hardly, therefore, a matter of surprise to find works upon works engaged in such industries occupying sites on a stream up to within a few hundred yards of its source. The result of this is, of course, to absorb the whole, or nearly the whole, volume of the stream which is the outlet of the drainage of the adjacent country; a further result is to put on one side altogether the right of the dweller on the bank of the stream, and general riparian rights to, and interests in, the use of the water of the stream.

By this action it would appear to be sometimes assumed by the polluter that the extent of the evil, or the magnitude of the profits arising from the *abuse* of the water in various processes of manufacture is in itself a sufficient justification.

It is only in very rare instances that anything in the shape of serious efforts have been made by such manufacturers to deal with their effluent waters; and generally such attempts have taken the form of inadequate, clumsy, and badly designed settling tanks and filter-beds, or arrangements for straining the foul water through canvas or coarse cloth, followed by very imperfect filtration. But in a very great number of cases the foul waters are simply allowed to pass away as best they can, without any effort being made to effect any improvement or to remove the polluting and noxious matters with which the water has become so grossly contaminated.

These foul waters are thus rendered dangerous to animal and vegetable life; and thence by passing along into the rivers, and mixing with the sewage matter contained therein, a fresh danger arises.

The river is thus converted into a most noxious and offensive liquid, destructive to animal and vegetable life alike, and a

grave danger to the public at large. The whole volume of water is thus rendered not only useless, but absolutely dangerous, without previous purification, to those lower down the stream.

The black, filthy, fetid river, carrying with it every species of abomination thus proceeds on its course—a common sewer. The Municipal and other sanitary authorities complain, generally, that the rivers are polluted by sewage and manufacturing refuse of all kinds before the waters reach them; that such rivers are offensive to the sight and smell; that they are dangerous to health; that they are injurious to steam engines and machinery. But, in spite of all this, such authorities all continue to pour, and allow to be poured, all kinds of liquid filth into the streams, and thereby convert them into common sewers.

It would, therefore, appear to be a decided advantage, from every point of view, to prevent the waste polluted waters from industrial operations mixing with sewage matter at all. There does not appear to be any reasonable cause why every manufacturer should not be compelled to deal with his polluted waters on his own premises.

The prevention of pollution by liquid manufacturing refuse undoubtedly possesses very much more formidable difficulties than dealing with sewage alone; while the difficulty of dealing with the compound pollution—sewage *plus* manufacturing liquid refuse—is no doubt very much greater than either.

From my intimate knowledge of, and daily experience in, manufacturing operations necessitating the use of very large volumes of clean water, I have no hesitation in saying that every one of the polluting-liquids from the works referred to, and which at present damage the rivers to such an incalculable degree, can be kept out of the streams altogether. Such foul waters can *in every case* be sufficiently purified to admit of their passage into the river without the slightest prejudice to it. This can be readily effected without interfering with existing manufacturing operations or interests in any way; and in most cases it would appear to be accompanied by a decided profit to the manufacturer. The waste-waters from the several industries mentioned appear to be among the chief sources of such pollution, as the tabulated results of my analyses show.

In the cases of the North and South Esk rivers, it has been amply demonstrated several years ago what the manufacturers on those rivers could do when compelled; and I have no doubt that if our Sanitary Authorities, who have already powers under the several Local Government Board, Public Health, and Rivers Pollution Prevention Acts, to deal with offences of the character

indicated, would only exhibit a little more energy in applying and enforcing such powers, we should find a corresponding improvement in our rivers and canals, and consequently a lower death rate.

Possibly the most effective and economical method of dealing with the enormous volume of pollution from manufacturing sources is by concentration and evaporation, followed by condensation. This system presents the least difficulty, and certainly yields much more satisfactory results than any system of chemical treatment, settlement, or filtration. Enormous volumes of highly polluted and poisonous waters can be quickly and most cheaply dealt with by specially designed evaporators, the best type of which would appear to be the Theisen-Ashworth, which serves the purpose of "smoke-washer" as well.

The foulest effluent from manufacturing operations can thus be readily and cheaply disposed of by evaporation, and condensed, and consequently clean soft water returned to the river in its stead. This may therefore be looked upon as the latest, best, and most scientific and successful solution of the problem of economically dealing with manufacturing liquid refuse.

The President of the Section (Mr. James Lemon) said he could have wished that the paper they had just heard had been read in Manchester, for in the neighbourhood of the Irwell it must have lead to a discussion of great length. He contended that the polluted water from the manufactories should be kept clear of the sewage, for its presence enormously increased the difficulty of precipitating sewage. To put the matter plainly he asked, was the larger part of the community to have its difficulties increased and to incur a large amount of expense to favour a small minority? The amount of polluted water which found its way into the sewage was a small thing compared with the whole of the body of the sewage, but it largely increased the difficulty of dealing with it. The difficulty he felt might be remedied by collecting all the polluted water in an iron pipe, taking it to some common point and dealing with it by chemical or some other known means. He thought it would be fair to the manufacturers if the whole cost of this operation was levied upon them and he believed they would meet it readily.

Mr. H. P. Boulnois, M.Inst.C.E. (Liverpool) said the remarks the President had made had rather forestalled him, but coming from the North he could cordially agree with what had been said. The paper would have been a great benefit if it could have been read in the neighbourhood of Liverpool. No one who did not live in the North could imagine the extent to which rivers were polluted. There was

no occasion for analysis to be taken, the water was often as black as ink and worse than an open sewer, and this was mainly due to manufacturers' refuse. The difficulty of dealing with the question was however very great, and there was he believed a great field open for chemists to find out how some use might be made of manufacturers' refuse and waste. The suggestion made by the President of a special sewer was he thought a very good one. In Liverpool the waste water from chemical and other works had actually been found in some cases to destroy the sewers into which they flowed, and they had now had to put in special acid proof sewers to carry off these objectionable waste products, which were in addition often turned into the sewers at high temperatures.

Mr. J. Oldfield (London) said the writer of the paper spoke of the growing pollution of rivers. Speaking as a Barrister he admitted that a manufacturer might have the legal right to pollute a river to a certain extent. But, say a manufacturer had a right to throw in a hundred gallons of refuse a year, if they looked into it they would find that this amount was increased year by year, so that by imperceptible degrees more and more damage was done to the river. He thought that the section ought emphatically to express the opinion that it was inimical to the welfare of the community that these manufacturers, who had a title to pollute a river to a certain extent, should be allowed little by little to increase that pollution.

Major Lamorock Flower (London) said he cordially endorsed much that was contained in the paper and particularly with regard to the difficulty the polluted refuse from factories created in sewers. At Tottenham there was considerable difficulty in dealing with the refuse from an india-rubber manufactory, and the task of getting rid of the stinks from this had been insuperable. The London County Council had at last taken the whole of the sewage into its sewers and carried it away, to improve the condition of those eminently Sanitary places, Barking and Crossness.

Mr. J. Oldfield (London) asked if it was not within the power of the Section to pass some resolution upon the matter.

The President of the Section said he certainly thought they should do so, and moved: "That in order to prevent the increased pollution of rivers by manufacturers' refuse, enlarged powers should be given to local authorities to compel the manufacturers to purify the polluted water, and in default the local authorities should have power to carry out the necessary work at the cost of the offenders, and that The Sanitary Institute be recommended to take action accordingly."

Mr. J. Oldfield (London) seconded the resolution, which was carried unanimously.

"*Notes on Sewage Treatment*," by C. H. Cooper, Assoc. M.Inst.C.E.

As many papers and books have from time to time been written treating more or less fully of the various branches of the subject, it has appeared to the writer that a few notes setting forth points, although not new, might be viewed in a light which would add to their interest.

The writer proposes to divide sewage treatment into the three following classes:—

TREATMENT.	MEANS.	RESULT.
1. Natural ...	Irrigation and filtration.	Purification effected by nitrification.
2. Electrical.	Electrolyses, coupled with salts of iron from electrodes.	
3. Chemical ..	Addition of various chemicals.	Partial removal of organic matter in the form of a precipitate. Subsequent purification of effluent retarded.

Natural Treatment.

It is now generally admitted that the purification, or, as may be more correctly termed, the nitrification, of organic matter is effected by nitrifying organisms. Although there appears to be much doubt as to what particular organisms, when separated from their companions and placed apart from their natural home, will effect such beneficial results, still, nature has provided in rich moulds an abundant supply of these workers which can effectually reduce the most offensive organic matter to innocuous inorganic substances.

Similar supplies of micro-organisms can be cultivated in sand, even of considerable coarseness.

The writer has applied the term "natural treatment" to that effected by micro-organisms in the ground and filters. By taking advantage of the method of treatment afforded by nature, it would appear that the health of the surrounding

district is rather benefited than otherwise; thus, on the sewage farms competing for the City of London's prize, offered in 1880, the death-rate was only 4 per 1,000.

Mr. Rœchling, in his paper read in April last before the Institution of Civil Engineers, on the Berlin Sewage Farms, mentions that for the five years ending 1889 the total death-rate amongst a population of nearly 8,000 living on these farms (for the greater part misdemeanants), was only 9·75 per 1,000, and the zymotic death-rate 2·53 per 1,000; and he further states that "nearly every report mentions that in no recorded case of death was it possible to trace that it had any connection with sewage farming."

For many years past at certain sewage farms, of which Wimbledon is one, filtration through the ground to the subsoil drains has, as far as possible, been prevented, as it was found that a much better effluent could be obtained by allowing the sewage to run over the surface. This led the writer to believe that the work of nitrification took place at or near the surface; but it was not till the result of the Massachusetts State Board experiments on filtration of sewage was published that he saw it clearly demonstrated that such was the case. In this report the number of microbes found per gramme of sand and nitrogen per 100,000 parts at various depths is given in the case of filters Nos. 1, 2, 4, and 6. Taking the mean of the results for May and June, 1889, the microbes found in the 1st inch averaged 792,200 p.g., in the 2nd inch 473,120 p.g., in the remaining 58 inches 33,967 p.g.; and the nitrogen per 100,000 parts at similar depths was 64·71, 18·3, and 3·14.

The fact that the microbes near the surface perform the greater part of the work of purification leads us to the important question as to what soil provides the best home for these organisms to work in, and also whether more work is done where the soil is protected by a crop or left fallow.

The writer would impress the necessity for giving all irrigation ground even slopes without any places where water can lodge. The fall of such ground should be in excess of that usually given, not in any case less than 1 in 100, and may run to 1 in 20. The most perfect permanent irrigation meadows that the writer knows of are those laid out by the late Duke of Portland, which take the sewage of Mansfield. These meadows are supplied from a canal conveying the sewage in a rather dilute state; at one point the canal crosses a valley on an embankment; during heavy rains the reservoir formed by this embankment can be filled, and the water thus impounded used for irrigation during time of drought. For the most part the surface gradients of these meadows are considerable.

Mechanical Separation of Solids.

A considerable difficulty in dealing with sewage is occasioned by the organic matter being dispersed through some 2,000 times its weight of water. If we can mechanically separate part of such matter, in the great majority of cases it can be more readily dealt with, and the ultimate purification of the remaining water can be effected with less liability of nuisance or damage to certain crops. In the case of treatment by electricity or chemicals, mechanical separation forms an essential part of the process. Such separation may be effected by settling-tanks, filters, or to a small extent by screens.

So long as sewage has sufficient velocity, as it should have whilst flowing in a sewer, it can carry all fæcal and other matters generally met with; this velocity is partly or entirely lost when the sewage reaches the settling-tank, and here matters in suspension are precipitated, more or less efficiently, according to the retardation of the current, and the time allowed for such precipitation to take place.

Tanks should therefore be designed with due regard to economy, so as to reduce as far as possible all currents.

The horizontal form of tank usually met with is particularly favourable to the formation of currents when used continuously, so much so that part of the sewage stands for hours without being changed, and thus throws the greater part of the tank out of action.

Herr Carl Kinebühler, Town Engineer of Dortmund, designed a vertical tank, somewhat in accordance with a tank patented in this country many years ago. This tank consists of a vertical cylinder 21 ft. 4 in. diameter by 29 ft. deep, having an inverted conical bottom. The sewage is admitted at the base of the cylinder, where it is distributed by horizontal arms; from these it rises in a vertical direction to a series of troughs placed at the surface, by which the effluent is drawn off, whilst the suspended matter that falls is collected in the conical bottom, from which it can be drawn off while the tank is in work. In this tank there is little or no dead water; the precipitate that falls passes through the sewage as it flows up, forms as it were a continuous shower, which tends to fetch down any precipitate that may be rising. A tank of the sizes given is said to be capable of treating 1,000,000 gallons of sewage a day, and could be constructed about London at a cost of say £500.

To still further effect purification a layer of filtering material may be introduced instead of the troughs.

Mr. Herbert Wollhein has patented what he calls "the

radial system of sewage precipitation," which consists of two or more segmental tanks. The sewage is received in a round chamber at the centre, from which it can be admitted to one or all the segmental tanks radiating from the central chamber; the effluent is drawn off by a weir on the outer or circumferential wall. The tank bottoms face towards the centre when the sludge is drawn off. These tanks possess many advantages.

Filtration.

Filters for sewage may be divided into two classes—Roughing or simply mechanical filters, and Nitrifying filters.

A good example of small tanks with roughing filters may be seen where the High Level Sewer enters the Wimbledon Sewage Farm. These consist of two tanks 25 ft. by 25 ft. with a chamber between, into which the sewage flows, and from which it is admitted to the lowest level of the tanks by two valves; these act as outlet valves in cleansing the tanks. Near the surface the entire of these tanks are covered by eight inches of rough filtering material, and through this the effluent passes. For the purpose of treating the High Level sewage no chemical is admitted, and so great is the purification effected by this mechanical means that during the spring, summer, and autumn of 1889 the sewage of nearly 4,000 persons was continuously applied to two and a half acres, with the exception of a day or two's rest now and then.

These filters are roughly cleansed about once a week by allowing what water may be standing on the filter to flow down when the central chamber is emptied, and all sludge that has accumulated is allowed to flow to the sewage works where it can be pressed.

These filters act in no way as nitrifying filters, as the filtering material is not aerated. The writer has designed somewhat similar filters, which are now being constructed for Maybole, Ayrshire.

The best results obtained with nitrifying filters are those got by the International Purification Company, who remove the suspended matter from the sewage before it is admitted to the filter, and in addition take the precaution to keep the surface of the filters cleansed; by so doing a final cleansing to sewage is said to be given at the rate of 100,000 persons to the acre.

The sand filters experimented on by the Massachusetts State Board, where raw sewage of a dilute nature was admitted (without previous cleansing) on to a filter which received no cleansing, gave splendid results as to pure effluent, the amount treated being proportional to upwards of 5,000 persons per acre.

Chemical Treatment.

Although the prophecies of certain chemists as to the fortunes to be derived from chemical treatment have proved untrue, and further, it is now generally admitted that chemical treatment of itself cannot give a satisfactory effluent, still there is considerable misconception as to the amount of purification that may be effected by chemical means.

The following Table gives the results of thirty-four experiments made by the Massachusetts State Board of Health, which are borne out by a much larger number of experiments made by the same Board:—

Summary of Results of Barrel Experiments to Oct. 1, 1889.

	Cost of Chemicals per inhabitant annually.	Number of Experiments.	Per cent. loss on ignition removed.	Per cent. albuminoid ammonia removed.
Sewage after settling	$ 0·00	10	30	26
Effluent with—				
700 lbs. of lime	·11	5	39	33
500 lbs. alum	·23	2	27	40
500 lbs. alum and 700 lbs. lime	·34	5	37	48
500 lbs. copperas	·09	1	36	21
500 lbs. copperas and 700 lbs. lime	·20	6	48	50
120 lbs. ferric oxide	·13	2	64	33
120 lbs. ferric oxide and 700 lbs. lime.	·24	3	57	51
Average for chemicals	·19	...	44	39·4

Taking the average of chemical treatment given in this Table it shows a removal of about fifty per cent. more albuminoid ammonia and about the same percentage of combustible matter at a cost of ·19 of a dollar over mean settling of sewage. This appears a poor return for the outlay, but on the other hand the chemicals act as deodorants, and by so doing retard decomposition, and it appears from observation that nitrification in the case of irrigation is also retarded.

Many persons believe that the greater the proportion of chemicals that is added to the sewage so much more is the purification effected increased.

When Dr. Dupré and Mr. Dibdin, about 1884, suggested, as the best known process, that four grains of lime and one of protosulphate of iron per gallon should be added to the sewage of London, the quantities were ridiculed as homœopathic. One of the principal reasons for this recommendation is to guard against dissolving matters in suspension by the addition of more lime, as Mr. Dibdin stated in a paper read before the Institution of Civil Engineers in 1887, "the point it is deemed expedient

to guard against is that effecting the precipitation of the last few traces of solids. It is important that the putrescible matters in solution should not be increased tenfold for the fragmentary quantity it is endeavoured to remove in order to render the effluent perfectly bright."

The truth of this recommendation is clearly shown by Tables and diagrams given in the Report of the Massachusetts State Board of Health.

SCREENING SEWAGE.

The amount of work done by screens is small when compared with the other methods of removing solids, but in the case of pumping, and when it is intended to press the sludge, the use of screens cannot well be dispensed with.

[*For discussion on this paper see page* 217].

On "*The Treatment and Disposal of Sewage and of Sewage Sludge,*" *by* ARTHUR ANGELL, Public Analyst, Southampton."

THIS Congress would in my opinion scarcely fulfil its functions in entirety were not the above really great and important question duly discussed.

It is not proposed on this occasion to travel over much beaten ground, yet, by way of preamble, it appears to be necessary to make a short reference to the more immediate past history of what has been termed the science of sewage treatment.

With the introduction of water closets and sewers there arose the difficult question of how best to deal with the accumulated sewage, and it behoves this Institute to disseminate information which shall keep the public up to date in the progress made towards the solution of the problem.

The most natural way to deal with sewage is to return to the soil that which has been taken therefrom, and so to enrich the earth and quickly to make use of materials which would otherwise lie idle for a time. This is the cry which continually goes up from the irrigationists.

If we existed in primæval times and were here and there one

or two wandering specimens of natural man, we could carry out this programme most effectually no doubt, but as our lives of civilization are to a great extent lives of artificiality, our troubles which are the consequences of that civilization and artificiality must by art be governed and controlled.

That all excrementitious and waste matter shall be removed from the habitations of men, and treated in the best, the most rapid, and the most scientific manner, is now recognized as an imperative demand, it must not be shirked; its neglect by public bodies is nothing short of stupid, uneconomical, and wicked culpability.

Attention was at first wholly occupied in the endeavour to purify sewage by allowing it to flow upon agricultural land, and thus began what may be spoken of as the broad irrigation epoch, an epoch which is now fast passing away.

Broad irrigation with crude sewage has in most instances resulted in the production of nuisances; nuisances differing in degree from barely tolerable successes to miserable failures.

Serious complaints are being continuously made about the pollution of rivers and water-ways by effluents running away from sewage farms dotted about all over the country, and it appears upon the face almost needless to speak against sewage farming to members of this Institute; and yet, from time to time in print and in speech, one keeps hearing the proceeding lauded up to the skies, and that by those who ought to know better.

The apparent naturalness of the process as compared with all others, a pretty widely spread ignorance of the process of assimilation by plants, and, above all, strong local interests in the sale and purchase of land, cause broad irrigation to die hard.

Listen to the names of just a few cases complained of in the public press:

Cole Hall Farm, Birmingham, 1889. Official complaints of the pollution of the river Cole.

Lincoln, 1890. Sewage farm declared to be a nuisance.

Beddington, 1889. Great difference of opinion as to the degree of success attained.

Burton-on-Trent, 1892. Action threatened by Derbyshire County Council.

Coventry, 1889—Kenilworth Farm. Dr. Wilson, Medical Officer of Health: "the results of analysis of sewage farm effluents shew that they cause serious pollution of the brook."

Harrogate Irrigation Farm, 1890. The Knaresborough Improvements Commissioners call attention to the pollution of the Nidd.

Nuneaton, Hinckley Farm, 1892. Samples of effluent were found to contain a large quantity of suspended matter and to give off an offensive odour.

Leicester, 1892. Thurcaston Brook, which before the opening of the farm was pure, is now foul and smells badly at times.

Croydon, 1892. The Local Government Board are of opinion that the Wandle is seriously polluted by the Croydon Sewage Works.

Lichfield, 1889. Pollution of Carborough Brook.

Oxford. Leading citizens declare their sewage farm to be a perfect White Elephant.

These are a few instances, hastily collected together, where broad irrigation has turned out a failure from a sanitary point of view.

One of the most recent contributions to our information upon the question of sewage treatment, is given in a paper read by Mr. R. F. Grantham, M.Inst.C.E., F.G.S., who argues that the experiments of the Massachusetts State Board of Health, made at Lawrence, 1888 to 1890, shew that it is possible, by filtration, to treat the sewage of London successfully upon the Maplin and Foulness Sands, by simply permitting the sands to be converted, by the carefully applied sewage, into vast nitrifying beds.

That author states that the results obtained are remarkable for the "large quantities of sewage which can be purified upon small areas of land." It appears to me to be somewhat strange that any person, by reading the report, can arrive at any such very comfortable conclusion. It is difficult to understand how anyone, noting the rate of filtration adopted, can argue for the feasibility of such a method for the treatment of Metropolitan sewage.

In order to strengthen his case Mr. Grantham has selected and named certain places as illustrations of the good work that has been done in this country by passing sewage upon sandy soils.

Several places are named, amongst which I notice first comes Aldershot—that town is now resting under an injunction for the pollution of the Blackwater, time being granted for the adoption of a better method of disposal.

Berlin. A correspondent to the "Newcastle Chronicle" of October 6th, 1891, declares that the "effluent certainly has not lost its odoriferous properties, for the waters of the Spree are simply stinking."

Edinburgh. Here are the celebrated Craigentinny Marshes, which the late Dr. Tidy described as a vast stinking morass.

Kendal. The pollution of the Kent by the effluent from the Corporation farm is now forming the grounds of serious complaint.

Surely Mr. Grantham did not make sufficiently careful enquiries, or he would never have ventured to name these places as proving anything worth recording.

A very interesting question for debate is, whether the power of a filter bed is due to direct or chemical oxidation, or to nitrification caused by the vital action of organisms.

The first polarite sewage bed was laid down in 1888, and from that time to the present a considerable number of large filter beds has been established, both for the purification of sewage and of water. These beds have been operating successfully, and will I think continue so to do for an indefinite period.

The mode of management of these beds has been laid down and guided by the belief that the purification is produced mainly, if not entirely, by direct oxidation—oxidation brought about by the actual contact of dissolved organic matters (in the case of sewage previously partly dissociated by chemical treatment) with the possibly ozonized oxygen occluded within the pores of the polarite.

Nothing that appears in the report of the Massachusetts experiments should, in my opinion, alter this well established procedure. We demand intermittence as a *sine quâ non*, but not in order, as do they, to allow the nitrifying germs breathing time, but simply to permit the atmospheric oxygen again to fill up the pores of the material.

I quite see the immense importance of this most interesting question, because if we are to convert our filter beds into aërobian fermenting vats, a very different rate of filtration must be adopted, and the area now in pretty common use at sewage works, must be increased something like 50 fold.

Nitrification, caused by the vital action of certain forms of bacterial germs, cannot longer be a matter of dispute, it is settled; but I have found that newly made polarite, fresh from the retorts and therefore practically sterile, will oxidize dissolved sulphuretted hydrogen into sulphuric acid, and the albuminoid matters of sewage into ammonia and carbonic acid. That being so we must not get carried away into the biologists' dreamland by the results of the very admirable and very exhaustive, but at the same time very unpractical, Massachusetts experiments.

Dr. Dupré was, I believe, the first to suggest the possibility of treating sewage by innoculation with nitrifying germs. I well remember the guffaw of incredulous laughter with which this suggestion was received by a strong meeting of sewage

experts, and yet the idea was pregnant with good sense. Since that time the Massachusetts reports have been published, and now several chemists and biologists are engaged in this branch of research, endeavouring to find out a means of selecting and controlling the fermentative changes which take place in sewage, so as to avoid putrefaction and to ensure the higher and less noxious changes which lead up to purity.

This forms a very interesting study, but it appears to me that the bacteriological treatment of sewage is not yet within a measurable distance of practical or applied science. As in a drinking water, so in a sewage effluent which is to flow into a river from which water may be taken, we are not warranted in pronouncing an opinion on their character by estimating the number of micro-organisms present. Chemical analysis, incomplete as it is, with a close observation of physical properties, is the only means of judging of the safety of an effluent.

The Massachusetts experiments shew that a high degree of nitrification by the aid of organisms does take place in sand beds when sewage is passed through them intermittently, and that the deposit upon the beds is burnt up by the organisms, so that the surface remains permeable to sewage and the filtration may be continued indefinitely without a renewal or cleansing of the top sand.

This is a most interesting scientific fact demonstrated to satisfaction, and would constitute an immensely valuable discovery if the rate of filtration performed in the least degree approached the lowest speed which is found to be practicable in treating a large flow of sewage; that however was not the case. The speed of filtration was absurdly slow, namely, about 12 gallons per square yard of surface per 24 hours. A given portion of the sewage was stated to be slowly moving downward for a week over particles of sand intermingled with twice their volume of air.

In order to apply the sewage in a uniform manner all over the beds at one time, an ingenious sprinkling apparatus was devised.

These experiments undoubtedly prove that slow percolation through sand will purify sewage, and that the chief if not the only agents in producing nitrification were, what Pasteur entitled, aërobian germs. The process will be seen to be an admirable imitation of the way in which nature treats excremental matters which fall upon the land.

And yet on page 161, Part II. it is shewn that with a low number of bacteria and much oxygen the nitrates were high, and that with a high number of bacteria and limited oxygen the nitrates were low; this looks as though direct chemical

oxidation in some instances was going on as well as, if not to a greater degree than, vital nitrification.

To filter Barking sewage at the rate and in the manner set forth in these experiments, about 1,666 acres of prepared filter beds furnished with revolving distributors would be required, and in order to establish and maintain the proper bacteriological equilibrium it appears that this great area must be covered in and protected from rain and snowfall.

The most exhaustive trials of the various processes for the purification of sewage which have come under my notice are those which have been proceeding at Salford, from the year 1889 up to the present time.

The chemists engaged to report upon these trials were Mr. Carter-Bell, F.I.C., A.R.S.M., Borough Analyst, and analyst for the County of Cheshire, and Dr. C. A. Burghardt, F.R.M.S.

In a general sense these gentlemen report favourably of both the International Purification Company's, or the Polarite process, and of Mr. Webster's Electrical process; placing these two far above any of the other methods tried, as far as purity of the effluents obtained is concerned.

Speaking of the effluents produced by these processes, Dr. Burghardt makes use of the words "The effluents were excellent, and have not up to the present time undergone any secondary decompositions."

The mean percentages of purification tabulated on page 8 of the Salford report are given as follows :—

	International, per cent.		Electrical, per cent.
Free ammonia......	83·47	...	26·75
Albuminoid ditto...	79·50	...	60·00

On page 46 Mr. Carter-Bell gives the result of the analysis of a sample of polarite effluent which he collected at Acton in August, 1890, after the filter beds had been in operation for more than three years.

Taking the reduction of albuminoid ammonia as the index, the purification was 95 per cent.

Acton sewage is a domestic sewage mixed with much laundry soap suds.

Salford sewage is very largely composed of manufacturers' refuse liquors.

I am at the present time engaged in the conduct of experiments, the object of which is to determine the cause of the action of porous filtering materials, especially polarite, upon chemically treated sewage.

The results obtained so far indicate that the porous body,

when furnished with oxygen, possesses a selective, bacteriological power due to the action of the occluded oxygen upon the anaërobian or vibrionic forms of microbic life, allowing to pass uninjured those forms which produce nitrification.

These conclusions have been arrived at by noting the fact that albuminoid matters are changed by the action of new polarite into carbonic acid and ammonia, the saline ammonia of the effluent being in some instances much larger than in the original sewage.

An impure water has to pass through polarite in so finely divided a shower that it is in the state of a cloud or mist; by this means the impurities in solution are brought into immediate contact with dissolved and atmospheric oxygen, and direct oxidation of the carbon takes place, the nitrogen escaping in the effluent as carbonate of ammonia. At this stage no nitric acid has been formed, but nitrification speedily sets up in the filtrate, a few hours will produce a marked change in this direction; so that to judge where the nitrification takes place the analysis must be made immediately after filtration.

I do not find any statement as to whether or not this necessary precaution was taken in the Massachusetts experiments.

Brewery Refuse.

I have come to the conclusion that no practical method is known of treating a mixture of Brewery refuse and sewage when the former is present in anything like a large proportion. The living ferments which are washed from the barrels, and the high temperature of the waste liquors which escape from a Brewery, cannot fail to set up noxious fermentations in the sewers and at the works, and it is high time that all Brewers were compelled to impound these liquors in subsiding tanks until cool, and until the greater portion of the solids have separated by gravitation; this is being done successfully at one of the largest Breweries in England. It is not, therefore, too much to demand of the trade in general.

I will now conclude with a few words upon the disposal of sewage sludge.

Some years ago General Scott took out several patents for the making of Portland, or Hydraulic Cement, by burning sewage sludge with chalk or limestone, and there is no doubt he succeeded in making a useful cement from these materials.

The manufacture however did not succeed commercially in consequence of the immense quantity of water in the sludges at his disposal and the expense of obtaining chalk.

Now that sewage sludge is being pressed with lime into cakes containing about 50 per cent. of water, five tons of ordinary tank sludge being pressed into one ton of cake, the process is quite altered; it is simplified and cheapened, but there still remains the difficulty and cost of obtaining chalk or limestone at sewage works.

Protection has now been granted to a new process which promises to be a successful one, namely, the production of hydraulic cement from pressed sewage sludge cake, and waste gas lime from the purifiers as the two principal ingredients. The matter has been placed in my hands for experimental investigation. Some bushels of ground cement have been made by a well known cement manufacturer.

By this means two filthy bye-products, sewage cake and gas lime, both of which now await some useful means of disposal, can be converted into a material which is used in large quantities and purchased at high prices by Corporations and other public bodies. There is also much waste carbonate of lime accumulating at water works.

I am of opinion that much of the fish poisoning, which occurs from time to time in our rivers, is due to the use of poisonous gas lime as a manure upon adjacent land.

From a sanitary point of view this is a step in the right direction, and even if the cement produced should not vie with the best qualities in the market, the fact that the sludge now lying about in most sewage works in hundreds and thousands of tons, and accumulating at an alarming pace, and that useless stinking gas lime, can both be rendered innocuous by a process possibly remunerative, at all events economical, is a matter of the utmost importance, and in my opinion is well worthy of the special notice of the members of this Institute.

The samples of cement shewn were made under my supervision, and withstood a tensile strain of 293 lbs. to the square inch. or 659 lbs. to the $1\frac{1}{2}$ inch briquette.

NOTE.—A paper on "The Treatment of Sewage" was also read by E. SCRUBY.

[*This discussion applies to the papers by* C. H. Cooper, Arthur Angell, *and* E. Scruby.]

The Chairman (Mr. H. Percy Boulnois) said this was one of the vital questions of engineering. The papers had been most interesting, and he was glad to see that there were in the room champions of the various processes for the disposal of sewage. Taking Mr. Scruby's paper, it was certainly a novel process, but by the remarks in Mr. Angell's paper it appeared that oxygen was to play an important part in the purification of sewage. Of course, Mr. Scruby's experiment had only been made in the laboratory, and he regretted to say that when put into practical use many laboratory experiments had been found to fail. He should be pleased to hear when this one had been put to a practical test, and that it had succeeded. Sewage varied in almost every town, and it varied in amount and quality almost every hour of the day, so that any chemical process required a great deal of watching. Mr. Scruby had not said what he would do with the sludge that would be left. It must go somewhere, and what would he do with it? Then the cost for London would require £175,000 a year for oxygen alone, and that would make it most expensive. In his paper Mr. Cooper had laid before them valuable tables and very graphic diagrams, and to engineers these were most important. Those showing the effect of filtration were very interesting, as they could see that it was near the surface that the work was really done. He should ask Mr. Cooper, however, to explain this a little more fully, as it was a complicated matter. Mr. Angell's paper was especially valuable from a chemist's point of view, but the Chairman was certain that there were gentlemen present who would not agree with all he had said. The most important part, to his mind, was where Mr. Angell had stated that the results obtained by experiments made as to the cause of the action of porous filtering materials, especially polarite, on chemically-treated sewage, indicated "that a porous body, when furnished with oxygen, possesses a selective bacteriological power, due to the action of the occluded oxygen upon the anærobian or vibrionic forms of microbic life, allowing to pass uninjured those forms which produce nitrification." As to the making of cement, the invention Mr. Angell referred to was of enormous importance. If he succeeded in making cement from two such foul materials as sewage sludge and "blue billy," Mr. Angell would have solved one of the most baffling and difficult problems Sanitary Engineers had had to encounter.

Mr. Scruby (London) said that the Chairman, in making his remarks after the reading of the papers, made some reference as to the cost of oxygen gas required for the treatment of the sewage of London, based on my calculation. In reply to which he said, it would no doubt be accepted as a truth that a nation's health was a nation's wealth, and to those who accepted that statement it would neces-

sarily follow that this subject must be dealt with in a generous spirit, especially when the importance of its bearing on the health of the community is realised. He illustrated his meaning of the above by saying that if he had a nuisance on his premises detrimental to the health of the neighbourhood, he was served with a notice by the Medical Officer to abate the same, not even being asked whether he could afford the necessary outlay, or whether it would cost him £5 or £50. He had to comply, and therefore Local Boards and Sanitary Authorities must take a little of their own physic.

Colonel JONES, V.C. (London), said he was in favour of applying the laws of nature in the best possible manner. He welcomed Mr. Angell's study of the subject, because he could see that that gentleman was tackling it with great ability as a chemist. And he expected great advantage from his discoveries both with regard to polarite, and as to the cement. With reference to the latter, Colonel Jones said that he took great interest in the late General Scott's patents, and he wished Mr. Angell more commercial success than the General obtained. He was pleased to hear Mr. Cooper's paper, because Mr. Cooper was doing admirable work at Wimbledon, but he suggested that in the tanks as shown on the drawings the circular outside channel should be taken off, and the effluent drawn away from a single conduit on one side. Coming as an old practised hand to the consideration of the subject of sewage disposal, Colonel Jones said it was satisfactory to find that irrigation still stood first and foremost. A very interesting paper was read last May by Mr. Roechling, at the Institution of Civil Engineers, as noticed by Mr. Cooper, and he (Colonel Jones) desired to point out, as he did on that occasion, the great lesson to be learned from the management of the Berlin Sewage Farms. In his reply the author of that paper quoted the remarks that he had made, and said, "It was perfectly correct as Colonel Jones had stated, that the most important lesson to be derived from the paper was, that the success of the Berlin experiment was due to the intelligent supervision of the administration, and to the careful distribution of the sewage over the land. This was doubtless a point on which great stress should be laid." The pay of the officials for administration of the Berlin Farms came to £2,116 per annum, and that of sewage men to £6,989, or at the rate of £233 per million gallons of sewage per diem. This was simply for the manual labour of distributing the sewage over the land. Now he did not know of any English Farm in which more than half of the latter rate of payment was made for the distribution of the sewage only, and yet the daily wages of a farm labourer in England must be higher than in Germany. Moreover it had been the usual practice in England to employ an Engineer to "lay out," as it was called, the lands for sewage, once for all, and then to leave the future management in the case of smaller sewage farms, to labourers under the control of a committee of town tradesmen. Under those circumstances it was remarkable that irrigation had held its own against chemical and electrical efforts at sewage purification, which were always carefully

tended by a trained staff from first to last. What was wanted in England was a staff of Engineer farmers, and in these days of technical education they would soon be found if sewage committees would learn to appreciate their services and offer sufficient pecuniary inducement. He was inclined to think that Mr. Cooper went a little too far in ascribing to the popular microbe of the present day, all the functions of purifying sewage. He held, too, that the purification of sewage by a given area of soil protected by a crop was much greater than on fallow land, and he concluded that the joint action of the nitrifying organism and plant rootlets produced the best results in sewage purification. At the same time it was certain that the work of purification was done within the first few inches of the surface, more or less, according to the porosity of the soil allowing the passage of oxygen to support the life of organisms. If the sewage passed too rapidly through the first few inches, it either flowed away by the drains unpurified, or remained in an inert stagnant state for an indefinite period untouched even by the deep roots of wheat, &c. Mr. Cooper's remarks as to settling tank construction were quite correct, and the Dortmund form was one of the most satisfactory, but the avoidance of currents which is so essential to success, could be secured in various ways. At last, in the Massachusetts experiments set forth in Mr. Cooper's paper, they found an attempt to discriminate between the results of simple natural subsidence, and those produced by chemical agents. He had often protested against the assumption hitherto universally put forward by precipitationists, that the total difference of analysis between raw sewage and effluent from any particular process, was due to the employment of one or more chemical agents in the precipitation tanks. Taking the average of the sewage experiments tabulated in Mr. Cooper's paper, it showed that only about 50 per cent. of the work done by natural deposition had been obtained by the employment of large quantities of chemicals, and at a cost of 10d. per head per annum of the population where the sewage had been thus treated. His own experience would have led him to have expected much less percentage of useful effect, and a higher cost for chemicals and labour. He would very much like the London County Council to give them the difference in volume of sludge, and analyses of raw sewage, and effluent *with and without* the employment of 3·7 grains of lime, and one of iron per gallon, from which their chemists now claimed to obtain important results with regard to the metropolitan sewage; nothing could be simpler than to compare the results on alternate days, and in conclusion, he suggested that as the point was of great scientific interest, the Council of the Sanitary Institute should memorialise the London County Council to carry out the experiment.

Alderman Boulton (Burslem) said he should be glad to find that if tried there would be something of advantage to Sanitary Engineering in the new process. He was in favour of irrigation, and those who had gone in for the system were bold enough to say that it was not "fast passing away," as Mr. Angell had declared. No doubt Mr.

Angell had studied the subject thoroughly, and he (Mr. Boulton) congratulated him on the many points of great interest in his paper. Taking the sludge question, it was a great difficulty, and if it could be dealt with as Mr. Angell said, he for one would be pleased to advise Town Councils to adopt it. Some years ago a deputation (of which he was one) went to various places around London to investigate the various processes, but on getting back home, and considering the matter, they felt bound to come to the conclusion that irrigation was the system that was best suited for them, and the town adopted it. He was struck with a remark of Colonel Jones as to the way in which chemical processes were being carefully watched. He was quite astonished to find the number of places which had complained of irrigation, but he had come to the conclusion that because a thing was complained of that did not prove it to be useless. People often make complaints from various motives, some from interest and some from sentiment. It did not take a great deal to cause people to make complaints on the sewage question. However perfect it might be, they might consider that a sewage farm was scarcely the place to take their friends to for a pic-nic. It was not like a bed of roses. In Burslem, whenever complaints had been received the matter had been remedied. It was quite correct that the state of sewage matter differed at all hours of the day, and this might cause complaints at one time, and not at another. Taking all those things into consideration, he did not think that with all that had been done for the chemical process, it had been free from complaints. They had no fear as to their sewage farm, and they were not going to adopt another process from what he had heard at that Congress. They would wait and see the new processes tried, and in the meantime they were quite satisfied with irrigation.

Mr. C. H. Cooper (Wimbledon) said that if Mr. Angell had gone in for a list of complaints against chemical works, he would have had a much longer list than he had got against sewage farms. As to the River Cole, he was not aware of the existence of such a river near Birmingham. Mr. Angell mentioned Croydon, but he expected that he meant Croydon rural, which was quite another farm. As to Aldershot, that farm was troublesome, but that was because it was let to a farmer who mismanaged it. As to the Berlin farm, the River Spree was a stinking river, but that was not due only to the effluent, and it was unfair to say that it was. Mr. Angell said that fresh polarite would effect oxidation, but this was expensive, and what would be the cost of the purification of sewage if they had to continually get fresh polarite? Mr. Cooper questioned whether it was the polarite which effected oxidation. If it was, then why did not the International Purification Company place polarite at the surface in their filters, and not allow the sand to do the work before the sewage got down to where the polarite was placed! He believed that Mr. Angell was claiming a novel property for polarite in ascribing to it the functions of a policeman—arresting the baneful bacteria, while allowing the harmless ones to pass. As to filtration being slow,

it had been proved by the Massachusetts State Board experiments that the sewage of a population of upwards of 5,000 could be dealt with on one acre of land, and these experiments were continued for some time.

Major LAMOROCK FLOWER (Lee Conservancy Board) said, Mr. Scruby's scheme had not been tested on a large scale; he would like to hear something more about the matter, and when Mr. Scruby could prove that he had treated one million gallons of sewage per day, for a period extending over six months, and show an effectively purified effluent he would be glad to hear from him again. Major Flower welcomed Mr. Cooper, as a good, honest worker in the cause of the disposal of sewage, and he was glad to hear such valuable opinions as he had given them that morning. He was also pleased to hear Mr. Angell, or anyone who would help them to solve this difficult problem. He agreed with Mr. Angell's remarks about the mixture of town sewage with manufacturers or brewers' refuse in the sewers. He also agreed with Colonel Jones that it would be quite as well to try the experiment of the effect of simple deposition, without applying chemicals. Sewage farms were very valuable, but care must be taken in the selection of the site and of the soil. He remembered one instance where the soil was yellow clay; in the wisdom of the day, the clay had been under drained, the result being that the clay cracked, and the sewage got down the cracks unpurified into the drains.

Mr. ROGERS FIELD, M.Inst.C.E. (London), said he must protest against Mr. Angell using such a phrase as "it appears on the face almost needless to speak against sewage farming to members of this Institute." The members of The Sanitary Institute as a body have never expressed any opinion against sewage farming. On the other hand, many competent Engineers were of opinion that if sewage farms were carried on properly this was the best way of disposing of the sewage of a town. He did not think, therefore, the phrase ought to have been used. No doubt there were cases where chemical treatment was the best method, but it should not be advanced as a panacea. It so happened that he had to do with the first case where chemical treatment had been applied to sewage on a large scale, viz., at Leicester, some forty years ago. He was the pupil of the Engineer to the Works (Mr. Thos. Wicksteed), who, as well as the other people connected with them, thought they were going to make their fortunes, but on the contrary they lost their money. Then another scheme came up but this also failed. That made him watch very closely everything that happened of this kind, and every new chemical scheme that came up. The number of chemical sewage schemes which had come up in his time was very large. They were wonderful in the Laboratory, and the promises of their inventors were magnificent, but in four or five years little or nothing more was heard of them. Therefore he not unnaturally doubted this one until he had seen it in practical use for several years. He had also seen sewage

farms which were failures, but in every case where this was so, it arose either from placing sewage on land that was altogether unfit for the purpose, or from improper management or neglect. Often they could see a farm which the Engineer had left in a beautiful condition allowed through neglect to get into a simply filthy state. If they spent anything like the money on the management of sewage farms which was spent on chemical schemes they would get results that would be very satisfactory.

Mr. A. Angell (Southampton) said that as to Mr. Cooper's point about the sand doing the work on the top of the polarite, it must be remembered that in his paper he quoted experiments made with new polarite, and the reason this was taken was because it was sterile. In polarite, as in all porous bodies, there was a selective power that would separate the lower forms of microbic life that caused nitrification. But he did not claim that for polarite alone; he claimed it for all porous bodies. Mr. Cooper therefore did not appear to have exactly recognised this point. With regard to the severe rebuke by Mr. Rogers Field, he did not think it was too severe. He had intended to say something that would bring a storm about his head, because there was nothing that so well brought a thing out as to have a storm over it, but he admitted that the expression was too strong. He had been asked for some particulars as to the quantities by which he had been governed in the production of the cement. In the early stages they could only get at the amounts approximately. The sludge he got at Salford, but it was the same all over the country. The weight of the sewage sludge of 1000 persons per diem was, say, 75 lbs. net, and this, with 225 lbs. of gas lime, would give 300 lbs. of cement. Multiplying that by 50 would give 15,000 lbs., or seven tons per diem—say five tons. A town of 50,000 inhabitants would require works of the following size: a mixer of 10 ft. diameter; a drying floor 20 ft. by 50 ft.; two ten-ton kilns, 15 ft. high with 15 ft. cupolas; grinding machinery, &c. The cost would be about £1000 and the labour about £6 per week. If they put the cement down as worth 30s. per ton, and allowed 15s. per ton for cost of production, that would leave 15s. profit, making a profit of £3 15s. per day. The cement manufactory for a town of 50,000 inhabitants would be a small affair. As he had stated, the specimens of cement before them were made under his supervision, and it had stood a test of 293 lbs. to the square inch. It was quite inodorous and not in the least objectionable, and he contended that it was better than that used on the Thames Embankment.

In reply to the discussion, Mr. Scruby said he did not deal with the solids. They would be left in the filter. In replying to a question from the Chairman as to what became of the solids in the oxidation chamber, he said none would be allowed to enter, as they would be left in the sand filter previously to the liquid being treated.

Mr. C. H. Cooper (Wimbledon), in reply, assured Colonel Jones

that his suggestion to do away with the troughs and draw off the effluent by a weir round the Dortmund would be impracticable, as it would leave a large body of fluid in the centre of the tank always unaffected, as the current naturally would follow the sides. Mr. Cooper was glad to find that Alderman Boulton was in favour of sewage farms. Where it was found absolutely necessary to separate the solids by some means, it could not be better done than by a proper system of tanks and roughing filters. Some speakers had alluded to certain land being unsuited for sewage, but he thought that if properly handled almost any land could be made suitable. Stiff clay land should not be drained, and by attempting to drain it the chance of a good effluent was generally lost.

SECTION III.

CHEMISTRY, METEOROLOGY, AND GEOLOGY.

ADDRESS,

By W. J. RUSSELL, Ph.D., F.R.S.

PRESIDENT OF THE SECTION.

"*A Sketch of the Chemical History of the Air.*"

I regret that my knowledge and experience of sanitary matters does not allow me to address you on a technical subject, appropriate to this Congress, and for that reason alone, were there no other, I think your Council have not acted judiciously in asking me to preside on the present occasion; but as they have done so, you must bear with me if I confine my remarks mostly to scientific matters and leave to you their application to practical purposes. I need not dwell even for a moment on the fact that sanitary science rests to a very large extent on pure Chemistry, and that the increased power which you have at the present day of doing good, depends on the advances which pure Chemistry has made of late years. Of the subjects with which the sanitarian has to deal, air and water are probably the most important. Water, from a chemical point of view, has I find been ably dealt with by a former President of this section, Dr. Dupré, and I have consequently nothing to say to you with regard to it, but I thought possibly it might be of some interest and I hope of some slight use, if I attempted to-day, to sketch very broadly the steps by which we have attained to our present knowledge of the atmosphere. It is a subject which in detail would require a history of Chemistry even from the earliest time, but I want merely to lay before you a brief outline of the campaign to show you how the subject has been attacked, how Generals have sometimes been victorious and been able to capture and to hold important positions, at other times how they have failed in their attacks, or even if for a time victorious

their gains have been of no avail, for their army would not follow and occupy the vantage ground which they had reached. And further, how the means of warfare has of late improved, and how rapid and important have been the victories of late years.

Obviously it is not possible to imagine people living on this earth and being unacquainted with certain physical effects produced by the air, it blew upon them and upon their habitations, as it does now upon us, and they accepted this as an obvious occurrence which happened as a thing of course; but the first thing they learnt with regard to chemical properties of the air, and that from direct experiment, was, that it increased combustion. They blew their fires, first no doubt by their mouths, which did not prove that it was the air that they used; but artificial bellows were a very early invention, and it is worthy of note that the great inducement to study the composition of air has been its obvious connection with combustion. It is easy to see how it came about that the physical properties of the air were the first to attract attention. Hero of Alexander, whoever he may have been, in his treatise on pneumatics, clearly described the salient physical properties of a gas, for he demonstrates that air is matter and occupies space, and he says it is constituted "of particles minute, and light, and for the most part invisible," and that these particles are in contact but do not fit into one another, but void spaces are left between, so that when force is applied the air is compressed, and customary to its nature, falls into the vacant spaces from the pressure exerted on its particles, but when the force is withdrawn the air returns again to its former position from the elasticity of its particles. Clearly then at least some two or three hundred years before the Christian era the physical properties of the air were well known, but with regard to its chemical action the only knowledge was that it stimulated combustion, as shown by the bellows, and that bodies would not burn without it. Anaxagoras said, "air was an element," and Aristotle made it, as every one knows, one of his four elements, not that their definition of an element would exactly agree with ours of the present day. Aristotle meant a distinct quality of matter, it typified to him all bodies that approached in nature to a gas, and it is interesting to note in passing how long it took, and how much experiment it required, to convince people that there really existed different kinds of air. The dictum that air was an element, and that it had certain physical properties, satisfied the world for centuries, and until experiments became more chemical in their character, and men began to study the permanent changes of composition which bodies underwent, little or nothing further could really be learnt

about the air, and all were satisfied that their knowledge of the air was sufficient and complete; for even down to the middle ages the four elements theory of Aristotle was universally accepted, and now it is hardly a century and a-half since the air was shewn to be a mixture of two gases.

As I have already indicated, it is only the principal events that I can dwell upon, the mass of smaller events, so important in their aggregate, I dare not in this sketch discuss, so I pass at once to the work and views of Van Helmont, for with him really begin the chemical history of the air. He clearly establishes what was afterwards forgotten or ignored, that there are different kinds of air, for instance, his "gas silvestre" was carbon dioxide, and he states that it is formed both by fermentation and combustion; also he describes a "gas pingue" which is given off from dung and is inflammable, but notwithstanding his clearly distinguishing these gases from ordinary air, the world in general cared not for the distinction, and it was not till long after, that such a distinction was generally admitted and believed in. Although he did not hold to the doctrine of the four elements, for earth and fire he believed to be compounds, still air and water were to him elements. His work was principally done during the reign of our King Charles I.; he was born in 1577 and died in 1644. His work, which was remarkably original and suggestive, had not long to wait in order to bear fruit, for three Englishmen quickly succeeded him, to whom the history of the air owes much—I mean Robert Hooke, Robert Boyle and John Mayou. Hooke's "Micrographia" was published in 1665 and Boyle's first treatise in 1674. His "Memoirs for a general history of the Air" are full of interest and importance, giving the views and curious experiments of an able philosopher struggling with a physico-chemical investigation, and handicapped by the fanciful theories and superstitious feelings of former ages. Bravely and cleverly he works his experiments, and large is the amount of information which he obtains from travellers and others. Naturally the author of "Boyle's law" will dwell much on the elasticity of gases, and he always comes back to the spring or durable elasticity of the air as the quality which distinguishes it really from aqueous vapours and earthy exhalations. By means of the air pump he demonstrates that air is necessary for respiration, for motion, and in fact for the existence of animals. Then he goes on to try whether air can be "produced," *i.e.*, obtained in sensible quantity from bodies wherein it did not before appear. This is suggested by older experiments on nitre, for he says that learned men believe there to be a volatile spirit of nitre in the air, but from his experiments he does not find salt-

petre to be volatile at gentle heat, and at high temperature it has quite different properties. Many of our experiments of recent times are foreshadowed, for he says much in his treatise on the hidden properties of the air, and on effluvia given off by the earth; he says for instance that probably the subterranean parts of the earth send up into the air peculiar kinds of venomous exhalations, that produce new mental diseases in animals of a peculiar species, and not in others. It is interesting his dwelling on this selective power. He further treats of atmospheric dust, and gives a general method for discovering the salts in the air. He uses the blackening of silver chloride as a test to be applied to air, and then describes celestial influences and claims for celestial bodies, that they exercise definite physical action on bodies on this earth, and makes a feeble apology for astrology. He is also doubtful, but rather leans to the view, that metals grow when dug out of the earth and exposed to air, and it is a question whether tin, silver, lead and gold may not be produced in this manner. Curious and interesting as the misconceptions of the philosophers of the time may be, the real interest centres very much in this being the dawn of our knowledge of oxygen, and I cannot but repeat —for I think others have said it before me—that the simple neutral salt, nitre, has proved itself to be one of the most interesting and important chemical compounds known to history —and why? principally, I think, because 50 per cent. of its weight is oxygen. It was well known to the alchemists, and they discovered how to obtain a "most active and fiery spirit" from it, and it was really a study of this salt which led to the first discovery of oxygen in the air.

We may thank the striking fascination there is about the phenomena of combustion for leading us to a knowledge of the chemical properties of the air. That air was the "food of fire," that air "nourishes fire," and that the bellows was a practical application of these facts was known from remote antiquity, that like phenomena could be produced by nitre was also known, and hence Boyle says that learned men believe that there is a volatile nitre in the air, and, undoubtedly, this is the popular theory of the day.

Lord Bacon says that nitre contains a "volatile, crude and windy spirit." Thunder and lightning even were accounted for by the presence of this body in the air. This theory arose in a most natural and logical way, for it had been clearly demonstrated that there was a similarity of effect produced by calcining a metal in the air and by heating it with nitre or with the spirit of nitre.

Hooke, in 1665, in the *Micrographia*, appears really to

have recognised oxygen in the air, and to have described its most important properties, for he says that the dissolution of sulphurous bodies, by which he means combustible bodies, is made by a substance inherent and mixed with the air, that it is like, if not the very same with that which is fixed in saltpetre, and he seems to have been fully aware that this substance formed only a part of the air, for he says that the dissolving parts of the air are but few, whereas saltpetre abounds with these particles. Considering what followed, it is curious that so clear an account of the oxygen in the air should be given 227 years ago. These views of Hooke's were fully accepted and extended by John Mayou; in fact, in the treatise which he published at Oxford in 1674, he does not distinctly draw the line between his own experiments and Hooke's, but clear it is that Mayou made a large number of capital experiments and ably extended Hooke's views. He speaks of nitre air, fire air, nitro-aerial spirit, names which in fact he gives to oxygen, and he proves that a candle burnt in a closed vessel only a portion of the air is consumed, and shows that the air only in part consists of nitre air, whereas in nitre itself it exists in a concentrated form. He also states that the acid of nitre contains all the nitre air in nitre, but in it the nitre air is surrounded by particles of water, which tend to quench the burning body. The very name of oxygen he might have given to his nitre air, for he states that all acids contain it, that oil of vitrol, for instance, is sulphur united with nitre air; that wines become sour by absorbing it from the air, and that substances covered by fat or oil do not putrify. Again, he demonstrates that the increase of weight during calcination is due to the absorption of nitre air, and that in the case of the calcx of antimony an exactly similar calcx is produced by heating the metal with the acid of nitre and evaporating.

I must also mention that he proves that when camphor is ignited by a burning-glass in a vessel over water, the volume of air diminishes, and the camphor cannot again, either in such residual air or in air in which a mouse had been suffocated, be ignited. Many of his experiments relate directly to respiration, and he is aware of the connection which exists between respiration and combustion. Is it not evident, then, that at this time the main features of the chemical composition and action of the air were known and demonstrated by experiment? Still the world would not accept them, neither Mayou's contemporaries nor immediate successors would adopt his views, but what happened was that these very facts had, exactly 100 years afterwards, to be re-discovered by Priestley. Again I may group together three Englishmen who were the most active in

furthering our knowledge of the air—Black, Priestley, and Cavendish. Black showed in 1752 that his fixed air was a totally distinct gas from common air, that it was not any kind of modification of it, produced by impurities or otherwise, as the various gases till then had generally been believed to be. Priestley without knowing it repeated Mayou's experiment, showed that the volume of air was diminished by combustion and respiration, recognised the character of the remaining gas, and called it phlogisticated air; he went, however, further, and made as he says this important and surprising discovery, that living plants could restore to deteriorated air the power of again supporting combustion. Now the world was ready and able to understand and to be interested in his many experiments with air, and the subject rapidly developes. Not only has he learnt the composition of the air, but he has the means of analysing it and, as he believes, of determining whether it be good or bad air. He has proved that the oxygen, or as he called it dephlogisticated air, is the active spirit of the air, all actions depend upon its presence, determine then how much there is in a sample of air and you will know its goodness; the whole matter seems clear and to have fallen into his hands, for he had lately discovered nitric-oxide gas, and one of its properties was to "devour oxygen," and thus could it be removed from the air to be tested. His accounts of these experiments is worth quoting; he says: "I hardly know any experiment that is more adapted to amaze and surprise than this is, which exhibits a quantity of air which, as it devours a quantity of another kind of air half as large as itself, and yet so far from gaining any addition to its bulk that it is considerably diminished by it." He goes on also to say that "this diminution occasioned by the nitrous air is peculiar to common air, or air fit for respiration; and as far as I can judge from a great number of observations, is at least very nearly, if not exactly, in proportion to its fitness for their purpose. So that by this means the goodness of air may be distinguished much more accurately than it can be done by putting mice or any other animals to breathe it." And well may he say as he does immediately afterwards: "This was a most agreeable discovery to me, as I hope it may be a useful one to the public." He has, moreover, another reason for being pleased with it, and it shows how the air had previously been analysed. He adds: "As from this time I had no occasion for so large a stock of mice as I had been used to keep for the purpose of these experiments." I must not stop to criticize his methods of analysis; he seems to have found the amount of oxygen in air to have been about one-fifth of its bulk, which was correct, but his method as an accurate way of determining small differences

in the amount of oxygen, and thus, as he thought, of determining its wholesomeness, completely failed. He makes a great number of experiments, gets the worst kinds of air he can, and compares them with the pure air of Wiltshire, where he is living. Mr. Boulton, of Birmingham, sends him a variety of specimens of air from that manufacturing town; Dr. Percival sends him specimens from Manchester, but he is able to find only very small and uncertain differences in the contraction given by pure air and the worst air from the manufactories in Birmingham and the weaving shops in Manchester. He also tries to solve the questions whether the amount of oxygen in the air varies at different times of the year and in different states of the weather, but his conclusion is that his errors of experiment are quite as great as any difference which may exist; and he quaintly and honestly says, "When I first discovered the property of nitrous air as a test of the wholesomeness of common air, I flattered myself that it might be of considerable practical use, and particularly that the air of distant places and countries might be brought and examined together with great ease and satisfaction, but I own that hitherto I have rather been disappointed in my expectations from it." Still Priestley did much good and important work in this direction, and he called attention to, and made many experiments on, the air in ill-ventilated rooms, some of his remarks are rather curious and quaint, he thinks small dining rooms are rather preferable to large ones, because on opening the door a large proportion of the total bulk of air in the room is changed, but if large rooms are to be used then there must be an opening at the top of the room to let the bad air out. He describes also how, without attracting attention, he bottled up at a dinner party a sample of the air of the room, in an empty decanter, and found appreciably less oxygen in it than in the air from a well ventilated room in the same house, but I am afraid his analyses were not quite reliable, for on re-calculating his results, the pure air must have contained 25 per cent. of oxygen, and from some other comparative experiments he concludes that had the dining-room air received a little more than twice as much phlogistic matter as it was charged with, by the breathing of these eight or ten persons, the effluvia of the victuals, &c., a candle would not have burnt in the room, and the conclusion he comes to is, that the breathing such contaminated air for so long a time, as it is now the custom to do, at and after dinner, must be very hurtful; he consequently recommends that if such large dining-rooms are built, provision be made for letting out the vitiated air at the top of them, otherwise if it were not inconvenient on other accounts, it would

be better to have the dinner in one room and the dessert in another.

When we consider that these statements were made a century and a quarter ago, and at least express clearly the necessity and scientific principles of house ventilation, I am afraid we cannot pride ourselves on the advances we have made in these matters. Architects still build large dining rooms without the hole at the top to let the vitiated air to escape, and I have known cases in which it would have been more pleasant to have had dessert in another room.

Priestley to the end of his days believed in phlogiston, he never got beyond the idea that the air was a mixture of phlogiston and oxygen, which he called dephlogisticated air, this to him was really pure air, and what remained after combustion, although he knew the gas to be lighter than oxygen, and although Rutherford had described nitrogen, still it was to Priestley, phlogiston, or rather air saturated with phlogiston.

Following Priestley, other chemists, both in this country and abroad, adopted and modified as far as apparatus went, the method of air analysis, and imagined that they had demonstrated the healthiness or unhealthiness of different places by this means. Ingenhouse, for instance, found more oxygen in the air above the sea and on the sea coast, than at other places, and this explained their acknowledged healthiness, but by far the most important series of air analysis of the time were made by Cavendish and published in the "Philosophical Transactions for 1783." He with much care investigated this method of analysis, and pointed out how the Abbé Fontana's method, which seems to have been much used at this time, could be improved, and in place of measuring he weighs the air. He says that during the last half of the year, 1781, "I tried the air of nearly sixty different days in order to find whether it was sensibly more phlogisticated at one time than another, but found no difference that I could be sure of, though the wind and weather on these days were very various," also he tried "whether the air was sensibly more dephlogisticated at one time of the day than another," and also he tried "whether there was any difference between the air of London and the country, by filling bottles of air on the same day and nearly the same hour at Marlborough Street and at Kensington, but the result in all these cases was the same, the difference was never more than might proceed from the errors of the experiment, and by taking a mean of all, there did not appear to be any difference between them."

Thus ended, for the time at all events, this method of analysis, and the brilliant and important results most naturally expected

were never realised. Chemists of all countries agreed in condemning the method and sought other means for determining the oxygen in air, but within the last two years it is interesting to note that a proposal has been made to revive this old method of analysis, and Messrs. Wanklyn & Cooper state that in their hands "the method proves to be both accurate, easy in manipulation, and applicable to cases in which the other methods cannot be applied," and that they are thus able to restore this old method to its proper place.

Although this nitric oxide method was the popular one of the time still chemists were busy trying other processes; Scheele had used a potassium sulphide and a mixture of iron and sulphur for the purpose, but not with satisfactory results. Guyton de Morveau, in 1788, used a solution of liver of sulphur, also an impure potassium sulphide, and at this time phosphorus came much into use, as an absorbent of oxygen. At first it was used in the state of rapid combustion, and Reboul describes different forms of apparatus for the purpose. Seguin and Berthollet use this method, and later, the more convenient process of the slow combustion of the phosphorus comes into use. Lavoisier, even in his paper on phosphoric acid published in 1777, states that the burning of phosphorus in ordinary air causes a diminution of one-fifth of its volume. The very large differences in the amount of oxygen in the air which chemists obtained testifies how imperfect were the methods then in use. They remained however faithful to the idea, that the amount of vital air present must measure the wholesomeness of the atmosphere, and were much astonished when Davidson found that the air of Martinique, when the yellow fever was raging, contained 67 per cent. of oxygen.

Volta, it seems, as far back as 1778, used the method of adding hydrogen to air and exploding the mixture, in order to get rid of the oxygen; but although even at the present day this is by far the most accurate process known, still at first it did not yield satisfactory results, in fact the method was not properly understood and practised until Bunsen clearly defined the proportion which the explosive gases must bear to the total volume of gas, for the whole of the oxygen, and nothing more, to be removed.

Davy and Dalton, specially the latter, worked much at the analysis of air. Davy proposed a method of absorbing oxygen by means of a solution of muriate, or sulphate of iron, saturated with nitrous gas, but he soon found the process could not be relied on, and was in fact worthless. Dalton, as late as 1802, speaks favourably for the nitrous gas method, and says: "It is not only the most elegant and expeditious of all the methods

hitherto used, but is as correct as any of them;" but so impressed is he with the definite and multiple character of all reactions, that he finds that in a narrow tube 100 measures of common air combine with thirty-six of pure nitrous gas, forming nitric acid, and with double this amount—seventy-two volumes —in a wide tube forming nitrous acid, the residium in each case was seventy-nine or eighty measures of pure azote gas. He also experimented with Volta's eudiometer, but does not obtain accurate results, for he finds that 100 volumes of oxygen unite with 158 volumes of hydrogen. It is, however, but fair to say that the mean of his numerous analyses come surprisingly near to the true result, for he concludes that one hundred parts of air consist of seventy-nine parts of nitrogen and twenty-one parts of oxygen.

There remains but one other method for analysing air that I need notice, that is, by means of alkaline solution of pyrogallol. Chevreul proposed the use of this substance as early as 1820. When only small amounts of oxygen have to be withdrawn from a gaseous mixture the absorption is perfect, but when the amount is large there is believed to be an evolution of a small quantity of carbon mon-oxide, but we have it now on the authority of Hempel that if the alkaline solution be not too strong this error does not arise.

A sudden change now comes over gas analysis. I have pointed out how imperfect and inaccurate a process it was, suddenly it became by far the most accurate and refined branch of chemical analysis, and this was entirely owing to the ability and ingenuity of Bunsen. In 1857 he published his work on gas analysis, and showed how gases could be measured and how absorptions could be made with wonderful accuracy, and this work remains to this day a monument to Bunsen's ingenuity and skill as an experimenter. Like other processes when the highest degree of accuracy is aimed at, Bunsen's methods require a long time to carry out, and both Regnault and Frankland have suggested forms of apparatus, which, while attempting to retain the accuracy of Bunsen's method very greatly shortened the time which each operation requires. Frankland's apparatus, modified considerably from its original form, seems to stand alone for accurate and rapid work. For many purposes the utmost accuracy is not necessary and for such purposes the ingenious apparatus of Hempel is now much used.

We naturally now turn once more to the question, what have we learnt from these new and refined methods of analysis? Clearly we have learnt that, however accurate the determination of oxygen may be, it does not tell us what the wholesomeness of the air is, but it has told us that in free air there is always

very nearly the same amount of oxygen; in fact, so little is the variation, if any, of the amount of oxygen in air from the higher regions compared to that on the earth's surface, from the northern regions compared to the tropics, of winter air compared to summer air, that like Priestley and Cavendish, we may say that the errors of analysis seem as great as any differences which may possibly exist, only now our errors are only $\frac{1}{1000}$th part of what they were in their time.

Probably the most accurate determinations of the oxygen in air were the 14 analyses made by Bunsen at Marbough, one of them gave 20·97, another only 20·84 per cent. of oxygen and the mean of all the analyses gave 20·93. This exact number is singularly confirmed by the 203 analyses made by Reiset of air collected at five different places and analyzed by three different methods. Hempel has also made of late years a large number of analyses; in the air from Tromsö he found 20·92; in that from Dresden 20·90; and in that from Paris 20·89 per cent. of oxygen. We have then a tolerably well established standard for pure air, and with the exception of sea air, which is probably rather richer in oxygen but about which more knowledge is required, any departure from this amount means that it has been taking part in chemical changes and that probably new products will have found their way into such air.

At the present time probably the most interesting results to be derived from the accurate determination of the oxygen in air are in relation to this point, the using up of the oxygen, for it is difficult to suppose that two or three hundredths of a per cent. of oxygen can in itself produce any appreciable effect either on respiration or combustion, but at present we have very little information as to the effect on ourselves of air containing less than the usual quantity of oxygen and no impurities in its place.

Ozone very probably is always present in normal air, but unfortunately we have no accurate method of determining its presence. Its formation probably arises from electrical action and directly or indirectly from evaporation. It is said that the quantity present in the air is greatest in spring and gradually diminishes till the winter when it is least, and that it is more plentiful in wet than in fine weather. The characteristic properties of ozone are shared by hydrogen peroxide, which Meissner in 1863 showed was also present in air.

I feel that I must pass very rapidly over the history of the other constituents of the air. I should have willingly dwelt on the variations of the amount of carbonic acid in air, for they are indications of changes of the highest interest, but I shall only indicate a few of the principal points connected with them. MacBride certainly proved, as long ago as 1764, that quicklime

after exposure to air effervesced, and so demonstrated that ordinary air contained carbonic acid. Horace de Saussure was, however, the first systematically to investigate the subject, and in his "Voyages dans les Alpes" in 1796, showed that this gas existed on the mountains of Switzerland as well as on the plains. His son Theodore published a much fuller account of these experiments in 1830. The method used in determining the amount of carbonic acid present was essentially the same as that in use at the present day, namely, shaking up a considerable volume of the air with lime water, and estimating the calcium carbonate found, and the results which were obtained were fairly accurate and comparable among themselves, although probably rather too high.

From experiments, made between 1816 and 1828, Saussure finds in a wood at Chambesy, three-quarters of a league from Geneva, that the carbonic acid varies in amount from 6·2 to 3·7 volumes in 10,000 of air and he seems very early in his investigations to have attacked the questions of whether there is a distinct variation in the amount of this gas present in the day time as compared to the night, and in summer as compared to winter. His results are that during the day the average amount is 5·04, during the night it is 5·76 per 10,000 volumes, that during December, January, and February at mid-day the quantity is as compared with that taken at the same time during June, July, and August, as 77 to 100.

He also dwells on the curious accidental variations which occur; that in an extraordinary mild January the amount was 5·1, whereas the mean of many years' observations for this month was only 4·23, and that in August, 1828, which was remarkably cold and wet, the carbonic acid was only 4·45, whereas the mean of many years gives the amount as 5·68. Further, he shows that the air over the lake of Geneva contains less carbonic acid compared with air collected over the land, in the proportion of 98·5 to 100, and that the air of Geneva contained an average amount of 4·68, while that at Chambesey contained only 4·37; so that he really attacked and obtained distinct results on all the most important and interesting questions attached to the presence of this gas in the air, and modern research has confirmed his conclusions. With regard, for instance, to the day and night variations, Schulze made upwards of 1,000 experiments, and Levy 2,500, and Reiset, Armstrong, Muntz, and others, many more, and the mean of all these results is that during the day the amount is 2·99, and during the night 3·17, and the numerous experiments of Trucot also confirm this general result. No doubt this difference arises principally from plants decomposing this gas during daylight and exhaling it

during darkness. With regard to sea air Thorpe's results show that the absolute amount is about normal, and that these diurnal variations do not occur. The amount of this gas in air is so small that the absolute amount is not appreciably diminished by rain. Still, small as it is, it has been stated that the absolute amount of carbon in the air is greater than that in all plants, animals, and coal formations on the earth.

With regard to aqueous vapour, which is also always present in the air, I have only to remind you of the large increase of amounts which can exist as gas in a given space with comparative small increase of temperature, that a cubic metre at the freezing point can hold in the gaseous form only 4·871 grammes of water, but that the same space at 20° C. can hold 17·157 grammes, and I would note that the usual means of estimating the amount present in the air are physical not chemical methods.

If any other gas has a right to claim to be a constant and appreciable constituent of the air it is ammonia, and Lawes and Gilbert state that there is about one part in one million of air.

Leaving now the purely gaseous constituents of the air, I have a few words to say with regard to the solid matter which it always contains. This solid floating matter in our atmosphere Mr. Aitken says, "is every day becoming of greater and greater interest, as we are gradually realising the important part it plays in the economy of nature, whether viewed as to the physical, physiological, or meteorological aspects." Until very recently we have only thought of gases and vapours as accumulating and taking part in atmospheric actions, but now we know what striking and important results are brought about by the particles of dust which are always present. The great Krakatoa eruptions of 1883 have shown how dust on a large scale may be ejected into our atmosphere, and how persistently it may abide there and circulate round and round our globe. Some two hundred other volcanoes add from time to time their contributions of small solid particles, the sea is continually adding finely divided sea salts, and we cannot ride, or walk, or carry on any mechanical operations without adding dust to the air, and certainly ordinary combustion must be charged with also adding much solid matter to the air.

The beam of sunlight no doubt revealed, even in the earliest times, the floating particles in the air, but no one thought much of them. It was admitted that every person in the course of a life of ordinary duration swallowed a peck of dirt, and there the matter ended. Astronomers told us that meteoric dust was showered on our earth, and that interested and surprised us, but

it really remained for Mr. Aitken to give a vital interest and importance to this subject of dust in the air. I wish I could do more than simply lay before you a few of the more important results which he had taught us. Until he demonstrated the contrary, it was a satisfactory conclusion that a simple diminution of temperature was sufficient to cause the condensation of aqueous vapour, and thus produce mist, fog or rain; but he has demonstrated that gaseous water may condense and transparency not be interfered with, and that the condensation is not a change which only occurs in a saturated atmosphere, and he says: "If there were no dust in the air there would be no fogs, no clouds, no mists and no rain." That it is these dust particles in the air which form the "free surfaces," which determine the aqueous condensation and give rise to so many meteorological phenomena. What is a haze? It may be a nearly dry dust cloud, or more likely a collection of dust particles clothed with moisture; the dust must be there, and if the air be very dry, except the dust be excessive in amount, the air remains transparent and we have no mist, but if air becomes more charged with water, each particle of dust will condense upon itself a mantle of moisture, and scattering the light, transparency ceases. Thus can a simple increase of dust particles produce a mist, also can an increase of aqueous vapour do the same. With a difference of 4° between the thermometer and only 550 particles of dust in the cubic centimetre, the air was clear; with 814 particles it was medium; but with 1,900 particles it was thick. Had the dust particles been entirely absent, no amount of increase in the humidity of the air would have interfered with its transparency.

In summer when the greatest amount of moisture is present, naturally does a haze form more readily than in winter; in July, with a temperature of 61° F., the air was thick, whereas in November, when the temperature was 50°, the air was clear, although if anything it then contained most dust; from an increasing load of moisture may a haze become a mist, a fog, or end even in a down-pour of rain. If the relative humidity of the air be small the competition among the particles of dust is great, the larger ones carrying off the lion's share of moisture, and you have a mist coarse in grain; supply more moisture, the larger particles are at least in part satisfied and the smaller ones can seize and hold their share of moisture and the constitution of the atmosphere is changed and with it the optical effects. So can mists be built up which will not only scatter light to different extents but will produce a selective action and yield most delicate and lovely colours.

I spoke just now of definite amounts of dust as present in the

air and I must justify the use of such expressions. How can such determinations be accurately made, if I say it is by counting the number of dust particles in the air you may naturally consider it as a joke, and that the often suggested problem of counting the grains of sand on the sea shore is an easy task in comparison, but such is really the case. Mr. Aitken has most clearly shown how we may with ease and accuracy count the number of particles even of the finest dust which exists in air, and can even make sure that our task has been fully and accurately accomplished. I can here but indicate the principle of his method: each particle of dust he swells to a visible size by inducing it to condense on its surface a layer of moisture, it is a nucleus with a water covering, and if this be allowed to settle on a silver mirror each particle forms a drop easily visible with a magnifying glass. Take, then, a small sample of air, a known amount, say one or ten cubic centimetres, dilute it with air which is proved to be absolutely free from all dust particles, air filtered through cotton wool, saturate it with moisture, and introduce it into your flask with the mirror, so that a cubic centimetre of diluted air rests upon the mirror, then a stroke of the air pump causes condensation, every particle of dust becomes laden with its change of moisture and falls upon the mirror. The mirror, which is one centimetre square, is crossed by fine lines dividing it into squares of one millimetre in size, and by means of the magnifying glass above, it is easy to count the number of drops in certain of the squares, and on repeating the experiment a correct average of the number in a square is obtained, further it is satisfactory to be able in the simplest way to demonstrate that all the particles of dust have been deposited. The experiment from first to last is quantitative, and a simple multiplication gives the number of dust particles in your cubic foot, or whatever measure of air you may like to use.

As a general conclusion it is found, as we should expect, that most dust exists in dry and least during wet weather. The following numbers obtained by Mr. Aitken show this, and give an idea of the absolute number of dust particles in air at Darroch, Falkirk, after a wet and stormy night: there were 119,000 dust particles in the cubic inch of air, but on an average on dry days there were 521,000, but in a room the number rose to 30,318,000 in the cubic inch. During the last two years Mr. Aitken has been indefatigable in determining the amount of dust in the air at different places, not only in Great Britain but also on the Continent; but for these results I must refer you to his papers, and content myself with only illustrating how delicate his dust test is, and how important this method of examining air must become. The air on the top of the Finouillet,

a hill 1,000 ft. high, situated in the centre of a plain near to Hyeres, one might expect to be exceptionally and continually pure, it was found, however, that never less than 57,000 particles in the cubic inch were present, and this impurity was traced to the houses of the peasantry and to villages dotted over the plain, and although the hill rises abruptly the polluted air came to the top of the hill, driven up the slopes by the wind. On the 4th of April the number of particles present was remarkably great, as many as 410,000 in the cubic inch, and this number remained fairly constant during the whole day. How at such a spot could such a result be accounted for? this is what Mr. Aitken says with regard to it: "On looking in the direction of Toulon, distant about nine miles, it was seen that the wind was blowing direct from that town, and bringing the products of combustion to the place of observation; the smoke being traced for some distance from the town, coming in a straight line towards Finouillet. At a later date Mr. Aitken, when describing his experiments at Garelochead on January 28th, 1890, says they were remarkable, as they record the smallest number of particles yet observed, and that "on this occasion there was great difficulty in getting clear of artificial pollution, the great purity of the air enabling the existence of a house at a distance of half a mile to be easily detected." These cases sufficiently prove to you the delicacy and importance of dust determinations.

As far as experiment has yet gone, even air from over the sea contains its charge of dust, and the purest air from such a source still had its 300 particles in the cubic inch; and often a dust storm mounts to the top of the Rigi Kulm, and the impure air of Paris may be found at the top of the Eiffel Tower. Continuous observations are now being made at the observatory on the summit of Ben Nevis, and here the most dust-free air has been found, for under exceptional cyclonic conditions only thirty-four particles were found in the inch. I have but indicated to you a few of the very interesting results which Mr. Aitken has obtained. His proof that dust can cause the deposition of moisture in air far from its point of saturation, and that this power varies with the nature of the dust and with its size, is of high importance; and all who study his experiments cannot but be impressed by the wonderful ingenuity and ability with which his experiments have been both conceived and executed. To collect the particles in a dusty air takes time, and the complete apparatus cannot be readily taken from place to place; we are therefore further indebted to Mr. Aitken for devising a small and portable instrument, the koniscope, for testing rapidly and easily the air in our cities and our rooms, an instrument which I doubt not the sanitary

inspector will find of use. By means of it we do not attempt to determine the absolute number of dust particles in air, but we compel them to tell us by their action on a ray of light and the consequent colour produced, whether few or many particles are present. A short metal tube with glass ends, and supplied with moisture, is filled with the air to be examined; an attached air-syringe produces an exhaustion, and the accompanying decrease of temperature causes each particle of dust to become coated with deposited water; and now, on looking through the tube, there is no longer white light coming through, but the light is of a colour and intensity, which is dependent on the amount of dust present: either a series of colours may be produced, or it is easier to interpret the results by always producing a blue colour and judging by its intensity of the amount of dust present.

The succession of colours which can be produced by this instrument seem to follow the order of succession of colours in thin plates; there is, however, still much to learn with regard to the action of these different sized molecules of water on light, and we shall then know more definitely how the green and blue tints, which have from time to time been seen, are produced. (One of these instruments was exhibited.)

Mr. Aitken has roughly calibrated his koniscope by using the same air as in his larger and counting apparatus; and to make the use of this instrument clear, I would quote a few of his results. When air containing 820,000 particles in the cubic inch is experimented with, the bluish colour produced is only just visible; when 1,310,000 are present, the colour is a very pale blue; with 24,580,000 it is a fine blue; and with 41,000,000 it is a deep blue.

The following is Mr. Aitken's account of an experiment with this instrument, and it shows, as he says, how we may trace the pollution taking place in our rooms by open flames. The room is tested in every part, and the inside air gives, like the air outside, only the faintest colour. Three jets of gas are then lit in the centre of the room, which has the dimensions of 24 × 17 × 13 ft. Within 35 seconds of striking the match to light the gas, the products of combustion had extended to the end of the room, for the colours in the koniscope had become dark blue; in 4 minutes the deep blue producing air was found at a distance of 2 ft. from the ceiling, and in 10 minutes there was evidence of the pollution all through the room. It was strongly indicated near the windows, owing to the downward currents of cold air on the glass, and the impure down currents could be traced to the floor and onwards to the fireplace, while a pure current could be traced from the door to the fireplace. We can thus make impure air visible, and by this means we may be able

not only to enforce the necessity for ventilating, but may learn how ventilation can best and most surely be effected.

As briefly as I could, I have laid before you the most important steps by which we have attained to our present knowledge of the constitution of the atmosphere; we may sympathise with Priestley and with Cavendish in the percentage of vital air not proving to be the sole test of atmospheric purity and wholesomeness, but at the same time we cannot but glory in the vast increase of knowledge which has sprung up since their time, with regard both to the composition and functions of the air. I had intended to have said at least something with regard to the more purely sanitary aspect of this subject, but must now not do more than simply allude to one phase of the matter which seems necessarily to follow from what has been said with regard to dust. I mean how far micro-organisms may be looked upon as so much dust, and be expected to behave as dust. Our information on this point, I think, is still deficient; these organisms, I conceive, must have the same kind of action on aqueous vapour, as other small particles of solid matter, and form more or less active centres for its condensation, and I could have conceived of spores and organisms thus embalmed remaining in, and travelling with the atmosphere for long periods and great distances; but as far as direct experiment at present goes, Percy Frankland, and others, tell us of the strong tendency which organisms have, owing to their weight, of settling out of the air, and their existence in the lower rather than in the higher strata of the atmosphere. That at least in the city of London the numbers decrease very rapidly with elevation, for Frankland finds that 10 litres of air collected at the base of St. Paul's contains 56 micro-organisms, that the same volumes of air at the stone gallery contains only 29, and at the golden gallery only 11. That our air is largely charged with organisms, and with spores there can be no doubt; again quoting Frankland he shows that on one occasion at South Kensington, 279 were falling on a square foot of surface every minute, and that at Kensington Gardens and Primrose Hill, some 85 fell, from the Mount Souris observations it seems that the numbers increase markedly after rain, and in summer as compared to winter. I believe, however, it has been satisfactorily proved that great epidemics, such as cholera, plague, yellow fever, influenza, are not spread in their ordinary course by the air, that from numerous careful observations it has been shown that they do not travel faster than human intercourse, and we may be thankful that such is the case, for from our present imperfect knowledge it would have been readily conceivable that the causes of such pestilences might have been

wafted for long distances, and have dwelt with their aqueous surroundings for long times in the air to have been precipitated at any moment on any part of the earth above which a sudden and sharp condensation arose. Actions of that kind to a small extent do occur, for the air in the immediate neighbourhood of infected spots, say a small-pox hospital, is known to be a medium by which infection can be spread to a short distance. The last century has then been productive of a vast increase of our knowledge of the air, and we may with confidence expect that in the coming century the increase will be even far greater.

Sir Charles Cameron (Dublin) said he did not think he had ever heard a more masterly exposition of the atmospheric air than that to which they had just listened. There were many persons who took no interest in the history of any subject whatever, and were inclined to look upon what was past as of no present interest at all; but that was hardly a philosophic way to look at things, and they learnt a great deal by studying the history of any subject. He had listened with great interest to the account of the early experiments with regard to the air, for there was no subject of greater importance to human beings than this, for they must remember that the weight of the air they breathed in a day was seven or eight times greater than that of the food and water they took in. He was especially interested in the latter part of the address, because there was nothing of more importance than the subject of aerial contagion, and Dr. Russell had shown how the air acted as a sort of aerial raft for disease germs. When making some experiments as to the sanitary condition of the Dublin barracks, he (the speaker) was surprised to find such different results in different parts of the building. The number of microbes in the air was fully three times greater in the dark part of the barracks than in the open squares. He moved "That the best thanks of this Section be given to the President for his lucid and interesting address."

Sir Thomas Crawford, K.C.B. (London), seconded, and expressed the opinion that the instrument for testing the air which the President had referred to was likely to be of the most important advantage to practical sanitarians, and that they were much obliged to the President for calling attention to it.

On Maps showing the Area of Chalk available for Water Supply in the London Basin. By W. WHITAKER, B.A., F.R.S., F.G.S., Assoc.Inst.C.E., Assoc. Soc. Medical Officers of Health.

A GOOD many years ago a set of maps was made, for the Metropolitan Board of Works, to show the area over which surface-water could get into the Chalk, the chief water-bearing formation of Southern England, in part of the London Basin.

Copies of these maps, and of others coloured in like fashion, were exhibited some years later (1883) to the Norwich Geological Society, when they formed the chief text of a Presidential Address.* Soon after (1884) these were again used at the Conference on Water Supply at the International Health Exhibition in London, when they were described from a different point of view.†

The meeting of the International Congress of Hygiene in London in 1891 seemed to be a fit occasion for the exhibition of a more extensive set of these maps (which had been made for the Geological Survey) and for the communication of a short note thereon. The maps were exhibited at the Museum in Jermyn Street, but the paper was not read (having been sent in too late to find its proper place in the Engineering Section), though a short verbal explanation of the maps was given in the division of Demography, at the request of the authorities thereof.‡

Since then some further work has been done, and some notes are now added to the unread paper referred to above, in the hope that this may be made acceptable to the present Congress.

On ordinary geologic maps large tracts are shown consisting of Chalk, where, as a matter of fact, it is rarely at the surface; but as on such maps, and also on the earlier Geological Survey maps, the Drift is ignored, a mistaken idea became prevalent that

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* On Some Geological Conditions Affecting the Question of Water Supply from the Chalk; *Proc. Norwich Geol. Soc.*, pt. viii., pp. 285-294 (1884).

† The Area of Chalk as a Source of Water Supply; *Journ. Soc. Arts*, vol. xxxiii., pp. 847-851. Reprinted in the "Report of the Conference on Water Supply," issued by that Society, and in "Health Exhibition Literature."

‡ An abstract of the paper is printed in Section vii., Engineering, p. 144 of the Report of that Congress, 1892.

over all, or nearly all, the tracts coloured as Chalk, that rock is accessible to water from the surface, and erroneous estimates of the area of Chalk available as a gathering-ground for water have therefore been made.

That the whole area usually coloured as Chalk is available as a gathering-ground is, however, not the case; for where Glacial Drift is present in force a thick mass of Boulder Clay generally comes between the Chalk and the surface. Where, too, there is none of this Drift the higher parts of the Chalk are often covered by irregular sheets of a more or less clayey deposit. In the lower grounds, too, the loam of the River Drift is of effect.

It follows, therefore, that only in those parts where the Drift and all surface-deposits have been mapped in detail can we tell, with any approach to exactness, over what areas rain can get into the Chalk, and can become available for underground water-supply.

This is the reason for the westerly boundary of the set of maps exhibited. We are not yet in possession of the Drift-mapping further west; but as this is published the maps can be extended. As to Chalk tracts beyond the London Basin, these maps can be made for the northern tract (Lincolnshire and Yorkshire) and for the Isle of Wight, but not for the rest of the Hampshire Basin.

Though based on geologic maps, these maps are not themselves strictly geologic, with one exception at least, the part coloured as bare Chalk. Passing from this to tracts otherwise coloured on the maps, it is well firstly to note that the colours do not show the permeability, or the reverse, at the surface. There are many tracts of permeable beds which, as far as accessibility of water to the Chalk is concerned, are impermeable, the porous beds at the surface being separated underground from the Chalk by less porous, or perhaps by impervious beds. On the other hand, however, all tracts that have impermeable beds at the surface are, of course, shown as such, though not separated from other tracts where the impermeable beds are underground.

It will be seen therefore that, in constructing these maps, underground as well as surface geology has to be considered: one must take into account the underground extension of impermeable, &c., beds, a matter often of some difficulty, and sometimes involving the consideration of troublesome questions of stratigraphy.

The first description of these maps was from a geologic standpoint, the effect of the different beds being noticed in their stratigraphic order. The second account was from the

standpoint of permeability, showing how the various divisions of the maps were made up. It will now be enough to describe these divisions, taking them in order of permeability, the reader being referred to the two papers in question for some matters of detail.

1. *Bare Chalk.* This division, coloured carmine, is taken direct from the Geological Survey map, on the scale of an inch to a mile, plain copies of which have been used for the set of maps exhibited. This, however, is the only case in which a geologic colour is absolutely followed, on account of the other divisions often depending on underground beds, and not only on beds at the surface.

Even in the case of the tracts coloured as Chalk there is sometimes an element of doubt, as soil often runs over the Chalk, which, though unmappable, may yet be of some effect in regard to the access of water to the Chalk. Where such soil is sandy, as is often the case, it probably makes little or no difference; but where clayey it may to some extent hinder the absorption of surface-water. It should be understood, therefore, that even over the area coloured as Chalk there may be spots where rain cannot pass at once into that rock. The basal part of the Chalk, too, is mostly somewhat clayey.

2. *Chalk covered by Permeable Beds.* Over the tracts marked by an orange colour the Chalk is covered only by beds that are practically permeable, such as gravel and sand. In other words, in these tracts nothing impermeable is known to come between the Chalk and the surface of the ground, the whole of that space being filled by permeable beds.

In many cases such tracts allow the access of surface-water to the Chalk about equally with tracts of bare Chalk; but in places where there is a fair thickness of permeable beds, some delay would occur in the water getting into the Chalk, and the supply might suffer slight loss. Moreover, there is sometimes, of course, a possibility of the presence in the permeable beds of unexpected masses of a less pervious character, which would have a like effect. On the other hand highly permeable beds often allow the downward passage of water much more rapidly than Chalk does, and for this reason a larger amount of water may sometimes get into the Chalk through a capping of permeable beds than would over bare Chalk; and this holds too where there is a sandy soil, as above-noted, on the Chalk. By sinking rapidly through some thickness of permeable earth water would be saved from evaporation.

3. *Chalk protected by Beds of Mixed or of Varying character.* In such questions as that under consideration, and indeed in most others where there cannot be absolute certainty, the spirit

of compromise should influence doubtful cases. It was soon found, in the progress of the construction of these maps, that there are beds that refuse to range themselves under the precise headings of permeable and impermeable. Some of these beds regularly take a middle place, being of such composition as to belong to neither class, but being partially permeable. Others have a varying composition: at one place all sand, at another all clay, and at yet another a mixture or an interweaving of the two. It being generally impossible to pick out these varying parts, they have to be treated together as a whole. In all cases where such beds as those described occur anywhere between the Chalk and the surface, and where no wholly impermeable beds also occupy that position, a green colour has been used.

4. *Chalk protected by Impermeable Beds.* We now come to the tracts that are unprofitable, or mostly so, as regards contributing to the store of water in the Chalk, though even here a gleam of light breaks through the darkness. In those parts coloured grey there is, somewhere above the Chalk, an impermeable bed that is enough to keep water from the surface above from sinking into the Chalk. This impermeable bed need not be at the surface, nor need it rest directly on the Chalk; it may come between permeable beds, but the effect will be the same.

It is found, however, that over tracts, sometimes of fair extent, where the direct sinking of water into the Chalk is thus barred, the rain that falls on an impermeable surface, or that sinks to this through overlying permeable beds, flows toward the outcrop of the Chalk, or to where the Chalk is covered only by beds allowing the downward passage of water. Then the small streams often sink into the Chalk, either wholly or partly, sometimes through overlying pervious beds, sometimes direct; and thus the impermeable tract contributes somewhat to the water stored in the Chalk. The swallow-holes that often mark the junction of the Chalk and the Tertiary beds are a notable case in point, and where these are frequent much water must pass down through them. Sometimes too artificial swallow-holes, made for drainage purposes, also contribute.

In consequence of this the grey areas have been sub-divided, a lighter tint being kept for parts where the drainage is toward the Chalk, a darker tint being used for the parts where the drainage is away from the Chalk, and where, therefore, no water can get into that formation. This is on much the same principle as that which gives the deepest black to the greatest heathenism, on missionary maps.

There are cases where the grey colour has been used with some doubt. In parts of Norfolk and of Suffolk, the Boulder clay is perhaps hardly to be called impermeable. It is some-

times rather sandy, more of a loam than a clay, and sometimes very chalky, being indeed mostly made up of pieces of Chalk in a chalky matrix. Here too this division of the Drift is generally of no very great thickness. In some places on the maps the partially permeable Boulder Clay has been marked by a border-line of green. The difficulty occurs only in parts that drain towards the Chalk, and where therefore the lighter tint of grey has been used.

While in many points these maps do not pretend to great accuracy, which is often indeed quite out of the question, there being so many doubtful points; yet, in all likelihood, such errors as must creep in are not great, and more or less balance one another, being sometimes one way, sometimes another. It must be clear of course that the special circumstances of various districts must be the subject of special enquiry, the maps being made for the consideration of the general question.

The making of these maps having been extended since they were described in 1884, it may be useful to give a list of those that have been done. In the following table the numbers are those of the sheets of the Geological Survey (or old one-inch Ordnance) Maps that have been used, and, as it is not always easy to make out the arrangement of the numbers, these are given so as to show the relative position of the sheets :—

			69	68	
			65	66	67
			51	50	49
		46	47	48	
34	13	7	1	2	
14	12	8	6	3	

Sheets 2, 49 and 67 (in small figures) refer wholly to tracts over which there is no access of water to the Chalk, and so are needless; they have been inserted merely to take the eastern boundary to the coast, from Norfolk to Kent. The northern boundary is the northern coast of Norfolk.

Sheets 12, 13, 14 and 34 have been done (or partly done) only lately, for the special use of the Royal Commission on Metropolitan Water Supply, use having been made of the MS. Drift work on the new Ordnance one-inch sheets; but those tracts outside the Thames Basin have been disregarded, the

enquiry of the Commission not going beyond that geographic district, which is far from the same as the London Basin, a geologic district. These four maps, as well as 46, are as yet imperfect, there being still some small tracts in which the Drift survey is not done; but with these exceptions the whole of the London Basin is in hand.

As sheets of the new one-inch map are published, with Drift, by the Geological Survey, it is hoped that the work of making the set of maps now described may be continued on them, and that their accurate topography will be of advantage, as compared with the more sketchy character of the old maps.

The CHAIRMAN (Dr. Russell) said that they had heard with much interest Mr. Whitaker's remarks. The great importance of pure water had been certainly impressed upon them of late years, and it had been proved by experience that the water held in the chalk—that big sponge—was in some respects the purest and the best adapted for domestic purposes. Such being the case, they must thank Mr. Whitaker for his important survey, and the time and trouble he had given to find out where that big sponge with the chalk water was. At the present time especially the question was of great practical importance.

Mr. ROGERS FIELD, M.Inst.C.E. (London), asked if the drift maps shown by Mr. Whitaker were similar to those recently published, and received an affirmative reply. He said that he had often to investigate the question of water supply and sewage disposal, and found that the ordinary geological maps were misleading, because it frequently happened that where chalk was shown on the maps they found stiff clay, and where clay was shown they found gravel. He should be very glad if the new maps shown by Mr. Whitaker were published for all parts of the country. Anybody who studied the question would see that the drift was of vital importance as regards water supply, for if they calculated on finding an absorbent subsoil such as chalk over a certain number of square miles and actually found it only over half of the area it entirely altered the problem. The drift maps were also very useful for questions of sewage disposal, and in several cases where he had had the opportunity of testing them, he found them remarkably accurate.

Mr. HENRY LAW, M.Inst.C.E. (London), remarked that Mr. Whitaker had told them of the circumstances which affected the entry of water into the chalk, but there was another important question which affected the water supply—its escape from the chalk. They might trace along the seashore in many parts, and in the Valley of the Thames, enormous volumes of chalk water running to

waste. In an investigation he carried on for two years in connection with the Metropolitan Board of Works (their object being to try and obtain a supply of water from the chalk), they found chalk water escaping into the bed of the river in the neighbourhood of Brentford, at the mean level with the tide. At Erith, too, they might see it escaping. The bed of the Thames from Vauxhall to Deptford was clay, which prevented the escape of the water, but at Erith they found water from the chalk which had fallen from higher levels now escaping into the river. He thought that if they sank deep wells and pumped they would lower the level of the water, and save a great deal which at present escaped.

Mr. F. Peake (Croydon) said he should like to mention a few facts relative to a supply of water from the chalk. He believed there was no doubt that water is obtainable at 100, 200, or 300 ft. down to the sea level. At about half-way between high and low tide on the beach there was fresh water. That he had often taken a drink from the beach under the cliffs of the South Downs. The owner of the estate of Blatchington, in making a pond on the Downs (about one mile from the sea) for his sheep, sank an artesian well, which now supplies the towns of Seaford and Newhaven. Brighton is nearly all supplied from a well sunk to the sea level, about one mile from the sea, which gives a constant and abundant supply. When he was at school on the hill at Brighton the well in use was he thought about 300 ft. deep down to the sea level. This was many years ago, long before waterworks and water companies were thought of.

Dr. J. Groves (Carisbroke) urged that it was very desirable that the geology of the chalk should be understood by the medical officers of sanitary authorities. The greatest mistakes were made by a want of knowledge, and he was afraid that even in that important community (Portsmouth) there were many persons who did not know the geology of the country about them. There were certain trustees of some property he knew who sank a well in the tertiary clays close to the chalk. They went down 200 ft. and found no water, and they gave up the attempt at last owing to the urgent representation of the local sanitary authorities, but they were very persistent in trying to get water from the tertiary beds for some small cottages, although it was near the surface in the chalk close by. He thought that all sanitary authorities ought to be compelled to provide themselves with these records of the valuable and important work done by Mr. Whitaker and his colleagues. The water taken for towns often prejudiced the local supply. It was thought possible in one instance he knew to supply a town of 10,000 or 12,000 inhabitants with water from a country district four miles off, and the landlord there sold his water, both surface and underground to the Corporation, who sunk a deep well and pumped from the green-sand. The result was, that they deprived all persons in the neighbourhood for a quarter of a mile

round of their water supply, and those people had now been for five or six years without water. They had had private inquiries of the Local Government Board, and had been trying to persuade, urge, or cajole the landlord into doing something, but they have not been able to get anything done yet, and the law did not go far enough to help them. If a house was without water they could not under the existing law compel the owner to provide a supply if the cost exceeded about £9, or in exceptional cases, with the sanction of the Local Government Board, the cost must not exceed about £13.

Dr. A. Newsholme (Brighton) asked if Mr. Whitaker had seen certain articles that had appeared in the *British Medical Journal* dealing with the water supply of London, in which the writer stated that the water from the chalk was diminishing, the landscape was altering, the tree growth was less vigorous, while the level of the water in the wells was being reduced. Of course, if that was correct, it meant that London would have to go for a water supply to a greater distance, and there had been a question whether that supply could be obtained from the South Downs. Would there be a sufficient store there for that supply without being in any way detrimental to the towns already supplied from this source?

Mr. Washington Lyon (London) asked if it was possible to get sufficient water from the chalk under London to supply that city by sinking wells in the centre of London. A well had been sunk there and a large quantity of water obtained. It was sunk by the Commissioners of Sewers for the City of London Artisans' Dwellings. The point was an important one, as supposing they could get so much water from that source there would be no necessity to go so far away for a supply.

Mr. W. Whitaker, F.G.S. (Southampton), in reply, said there was a peculiar weakness among agents for the Drift maps, for when asked for a Geological Survey map, they would give an old one if possible. There was a Royal Commission eight to ten years ago, engaged in examining the question of the pollution of the Thames, and the points they had to consider were:—(1) Whether the Thames was polluted, and (2) Whether they could prevent it. He was requested to give evidence, and was told that the Commission was supplied with Geological maps, but on attending, he found that they were the wrong kind, and it was not until he produced the Drift maps that the Commission saw that the question of application on land ought to be inquired into. Nothing special came of that Commission, but he mentioned the circumstance as showing that the old maps were not only useless but misleading, in such a case, as the Chairman (Lord Bramwell) said. With reference to saving the escape of water mentioned by Mr. Law it was a large and difficult question, things varied so in different places that it was really a troublesome question to deal with. It was true that when they got a free margin of chalk close to the sea they nearly always

found springs issuing, and they might even put their hands down into the sea there and get water tolerably fresh. There was a case at Brighton where a large quantity of water was got. When they were constructing the sewerage works they had to cut along the cliffs, and they were nearly flooded with fresh water. In some places near the sea they might sink wells and get good water, in others they could not do anything of the sort. They might sink wells in some districts a mile away from the sea and pump up salt water. There were parts of the Essex Coast where the majority of the wells gave more or less salt water, and there were cases in the neighbourhood of London, comparatively near the banks of the Thames, where wells yielded salt water, although not far off there might be fresh water springs rising from the Chalk. In one place, a little way off the Thames, fairly fresh water was obtained from the higher part of a well in the Chalk, but the deeper they went, the salter it got, and in the end it was found necessary to stop the lower part of that well and stick to the supply from the upper part. One speaker (Mr. Peake) had stated that the lowest well at Brighton was only 50 feet deep; but he had been down 150 feet. They had a good supply there and would not need to go deeper. Sinking a well in the Tertiary beds, as Dr. Groves had described, was a risky thing to do, it was not stated where that had occurred, but the best thing to do at Portsmouth was to take what the gods provided, and be supplied by the Waterworks Company rather than sink wells. As a rule he did not like Water Companies, he preferred municipalities, but he must give the devil his due, even if it were a water company.

There was a great defect in the Government organisation for the sale of maps. He believed he was the only person who had been allowed to go into the Ordnance Survey Office and get a map direct (since saying this the privilege had lapsed). The maps were prepared at Southampton, but even there they must get them through the agent appointed by the Treasury, so that the maps must go from Southampton to London and come back again, because a man in London paid £600 a year or so for the right of sale. While that sort of thing went on what could they expect? He contended that all these Government maps should be more easily obtainable, say, by being on sale in the Post Office in every large town. He should like to compel sanitary authorities to buy these maps, provided they could get them at a reasonably low rate. No matter what they cost they ought to be supplied cheaply, and if necessary be paid for out of the rates; the Government of anything but very poor nations ought to be above the notion of considering repayment by sale in such matters.

As regarded the question of supplies: if they had two pumps working and the larger pump took all the water, it was right it should do so, provided proper arrangements were made for supplying those who had been using the smaller pump. When a town-supply was being established in a district, arrangements ought to be made by the people of that district to protect their own interests. No big town should be allowed to go into a country district and take the water

without giving compensation for it, say, by supplying the people with water at a reasonable rate. At Southampton they had to go beyond the municipal boundary to get a large supply from the chalk. The local authorities in the villages protested, and the Corporation of Southampton said they would put up standpipes supplied from their mains, and the people could help themselves as much as they liked, and it cost the Corporation practically nothing. Of course if they had been dealing with a larger body, they would have had to offer to supply them at a low rate. Poor people suffered sooner than anyone else in this respect, and they really wanted a central authority to deal with such matters.

With respect to the case of Ryde, mentioned by Dr. Groves, the authorities ought to have offered a supply in place of that which they took away. Mr. Law had reminded him that there was no legal right to underground water, but there were more ways than one of killing a dog. If a small local authority objected to the action of a large Corporation in acquiring water in its district, both the House of Lords and the House of Commons would consider the equity before they looked at the legal side of the proposal, and they would say that the big corporation should supply the smaller authority. He had not seen the articles in the *British Medical Journal*, but they seemed to have some truth in them. As to the alteration in the face of the country, he was not prepared to say that the taking of water from any Chalk spring did not cause a change, but the face of the earth was always changing, though they would want "a double million magnifying glass" to see it, in such infinitesimal proportions was the change being effected. As to altering the water-level there was no doubt about it. If they took water at one spot, they must necessarily pull down the water level all round unless more went in. Then as to the question of the limit of water supply to London from the Chalk being reached, he should say that the limit had not been reached or anything like it except in the central parts of municipal London. In some places no doubt the limit of supply, without causing disastrous consequences, was near, but it was hard to say when it would be reached. Then as to the question whether it would affect the supplies from the South Downs; certainly not, that track was wholly away from the London Basin, but it would probably affect the springs and local supplies in the London Basin. There was a large amount of water in the Chalk, and in places a large quantity running to waste which might be taken without disadvantage to anyone.

The well in London which had been mentioned, was only one of hundreds. Say that there were 200 altogether, and what was the result? Why, that in nearly all, the water-level had gone down greatly, and some of them had almost failed. In London itself they were very near getting as much as they could out of the Chalk, which was less water-bearing beneath the great thickness of Tertiary beds than at its outcrop. With regard to that particular well, if the Corporation of the City of London had asked him about it before they began, with reference to a *large* supply of water being obtained,

he should simply have answered "No." For all practical purposes he thought the money was thrown away, and if 10 per cent. of it had been put into his pocket instead of spending it in that way, the rest would have been saved. The cost of pumping that water and supplying the buildings, according to the Corporation's reports, was some five times what they would have to pay to the Water Companies for the same thing. Being a rich Corporation they were right perhaps to try the experiment, but most folks who knew anything about it, would have guessed what the result was likely to be—that they would fail to get a large supply. If they thought that they were going to get water by simply sinking a shaft they were mistaken; to get a large supply, they must, as a rule, do large works, in the shape of driving horizontal galleries from the shaft, as had been done in various places. They had done it at Brighton, and as he should show later on, Portsmouth was unique in having a large supply without that trouble and expense. They had plenty of water at Southampton, but they had to spend money and do work for it. In nearly all large supplies they had to drive galleries as well as sink wells; they did not trust to shafts, which might or might not give a continuous supply.

On "Exhalation of Vapour from the Earth," by Hon. F. A. R. Russell.

In the course of observations on the deposition of dew and frost during 1891 and the present year, I had occasion to notice the considerable part played in dew-formation by vapour emanating from the upper stratum of earth, and especially of a sandy soil. Out of many observations I will select only a few which will typically illustrate the nature of the results obtained in a variety of circumstances. The results, as regards earth and surface temperatures, as well as the amount of condensation, refer to a locality on the south-western border of Surrey, a small level plot on an exposed ridge 630ft. above the sea. This situation favours equability rather than wide differences of temperature.

On June 10th, 1891, two tin pans, $21\frac{1}{2}$ in. in diameter and 4 in. deep, which had been exposed on the previous evening on the short grass of a lawn, were examined. One had been placed in the ordinary position and the other inverted. The inverted pan permitted a little air to enter under the spout, and also, to a less extent probably, under the rim. The first pan was only

slightly dewed on the exposed surface; the inverted pan was slightly dewed on the exposed outer surface, but very heavily in the interior. The night was fine with little wind.

On June 11th, 1891, four glass tumblers were exposed about 8.30 p.m. No. 1 was placed upright on the grass; No. 2 was inverted on the grass; No. 3 was placed on the garden soil of a flower-bed which was dry to the depth of a quarter inch from the surface; No. 4 was inverted on the same soil, and the rim sunk to a depth of about a quarter inch in the soil. On examining the glasses, which were still in deep shade on June 12th, at 8 a.m., No. 1 was found to be slightly dewed on the interior at the bottom of the glass; No. 2 was very heavily dewed on the interior, the quantity of dew increasing from near the ground to the upper part of the glass. On the outside of this glass there was a moderate quantity of dew on the top. No. 3 was scarcely dewed at all; No. 4 contained a moderate quantity of dew on the upper part of the interior. It may be mentioned that the dew on the outer surfaces had been partially dried off by a northerly wind.

On June 13th, 1891, a tumbler which had been inverted on the lawn was found heavily dewed on the inside all over, and on the top outside. A brass tray, about 10 in. in diameter, which had been inverted on the grass, was found to be scarcely at all dewed on the top, but very heavily dewed with large drops on the inside. A china tray, 7 in. in diameter, was found rather heavily dewed outside; very heavily on the under surface.

On June 15th, at 8 a.m., a round earthenware cover was found to be not perceptibly dewed on the outside, but the interior surface was very heavily dewed with large drops, which ran together on disturbance. An inverted glass tumbler, which had been similarly exposed, was heavily dewed on the upper part of the outside, and also on the inner surface. A glass lying on its side was heavily dewed on the inner upper surface and on the lower outer surface, but not at all on the sides; the upper outer surface was only slightly dewed. A glass, which had been inverted on a square flat china plate, which was figured with a raised pattern so that air could pass into the tumbler rather freely, was found heavily dewed on the top outside and only slightly on the top inside, the rest of the inside being undewed. The china plate, which was very slightly raised above the ground by its edges, was slightly dewed outside but very heavily dewed on the side facing the grass. The grass was not very wet, the dew during the night not having been a heavy one.

On June 17th, 1891, a flat china plate 7 inches square, raised about half an inch above the ground by four feet, was

found at 7.40 a.m. to be heavily dewed on the top, and still more heavily underneath, yielding, on being turned edgewise, a teaspoonful of water.

On December 19th, 1891, with fine weather and hard frost, the under sides of ferns and the leaves of bushes were found lightly, the upper sides thickly, frosted. Where there was thick fern between these and the ground there was no frost on the under surfaces. Leaves of bushes on open ground had a little white frost on the upper surfaces and films of transparent ice on the under surfaces, formed probably by the freezing of deposited dew. The weather of the previous three days had been clear, bright, and frosty, with very light airs or calm.

On December 20th, 1891, a tumbler, which had been inverted and driven firmly into the hard-frozen earth, was rather thickly frosted outside, moderately inside; one on a gravel path was similarly frosted. Two tumblers placed on the lawn were heavily frosted outside, moderately inside. The ground was quite hard during night and day.

On December 21st, 1891, leaves lying on the ground were much frosted on the top, and about half as much underneath. Stones of sandy composition were not frosted on the top, but much on the under surfaces, especially where touching and about half embedded in the ground. On being taken up, many of these stones carried some of the sand or earth with them. I was unable at the time to perceive the reason for the excess of frost on the under surfaces, which seemed contrary to the theory of dew as generally stated. Sticks were less frosted on the under than on the upper side. Thick planks, about two inches thick, some raised about one foot and some a few inches above the ground, were about a third as much frosted on the under as on the upper side.

In the night of June 28-29th, 1892, thunder-showers fell, the earth at the time being very dry. On June 30th the weather was very fine, dry, cold, and still, with a slight haze. At 5 a.m. on July 1st, a plate which had been inverted on the lawn on the previous evening was found thickly dewed on the top, but much more so on the downward face, so that forty-nine drops fell from the lower surface alone. A square white china plate, raised about half an inch, and having an inverted tumbler upon it, was thickly dewed on the top, but much more on the lower surface, from which forty-two drops fell. A flat brown earthenware plate was similarly more heavily dewed on the side resting on the ground. A tumbler inverted on the grass having a plate upon it, another tumbler being inverted on this plate, was thickly dewed outside, and on the lower half of the inside. The plate was thickly and about equally dewed on

the upper and lower surfaces. A plate with its edge raised and resting on the white china plate was found to be thickly dewed on both surfaces, most on the outside where most raised, and on the inside where lowest and nearest the earth.

At 7.30 a.m. the objects which had been left out since 5 a.m. were found to have notably increased their load of dew. The inverted plate had gathered so much that forty-two drops fell off it on being held edgewise, in addition to the forty-nine acquired during the night. A tumbler further exposed from 7.30 to 9 a.m. increased its deposit, became clouded, and even showed small drops inside near the grass. The shade from the hedge at this time was not deep, and the sun shone upon the grass about six feet distant. The night and morning were very fine, the minimum temperature was 39°, the temperature just above the ground at 5 a.m. was 46°, at 9 a.m. 53°, at three inches deep in the soil 51°, both at 5 and at 9 a.m.

It appeared from these last observations that in a state of soil forty-three to fifty-three hours after a thunderstorm following dry weather, the intervening days being fine and dry, a very much larger quantity of dew was deposited from emanations from the ground than from the open air, so that an exposed freely radiating surface was very much less wetted than an inclosed surface facing the ground and not radiating freely. The same conclusion holds good for the morning hours after sunrise, when the air and surface of the ground have greatly risen in temperature. The rate of evaporation from the earth seemed actually greater when the *surface* of the earth was colder than the air, than when it was warmer. Since a large quantity of dew is deposited in a tumbler raised a little above the earth, but a small quantity in a tumbler raised above a china plate, permitting equally free entrance of air, it appears that a great portion of the dew deposited on such a night is from emanations from the earth.

On July 2nd a tumbler, which had been inverted on bare dry garden earth on a slope facing west, and had been sunk one inch in the powdery soil, and banked so as to prevent ingress of air, was found to be little dewed outside, moderately inside. The earth was dry and dusty down to one inch. A plate which had been inverted on the lawn, where the earth was dry down to about half an inch, was found moderately dewed outside, but the inside was very heavily dewed, giving 62 drops. The night had been fine.

On July 3rd, at 5.30 a.m., a plate which had been inverted on the lawn gave 50 drops from the inside, and a plate which had been inverted on a sandy, dry gravel path gave 34 drops. The edges of this plate had been banked round with dusty

earth. A tumbler which had been inverted on the lawn was dry outside, moderately dewed inside; another, inverted over garden soil dry down to one inch, was slightly dewed inside; another inverted on a stake six feet above the lawn was dry. There was not much dew this night. The temperature at 5.30 a.m. was 54° on the ground, 56° at 3 in. in the soil; at 8 a.m., 64° on the ground, 58° at 3 in. deep; at 8.40 a.m., 68° on the ground, 60° at 3 in., and 63° at 12 in. deep.

On July 5th, at 7.45 a.m., a plate on grass gave 54 drops, on a dry sandy gravel path, 65 drops. This was a very surprising result, for the sand was dusty down to one inch, and only slightly moist several inches lower. At 8 a.m. the temperature on the ground was 57°, at 3 in. 55°. The night was fine and windy, the morning cloudy.

On July 9th, 1892, at 7.30 a.m., a plate on the sandy gravel walk, which had been banked round with sand and dry mould, gave 101 drops from the inner surface. This was the heaviest amount hitherto obtained. The surface of the gravel was dry down to about a quarter of an inch. A plate, of which the edges had not been banked round, gave only 73 drops in the same situation. At 9 a.m. the temperature half an inch above the ground was 64°; at 3 in. deep, 56°; at 15 in., 62°. The night had been fine and cool, with a moderate S.W. wind, and a minimum temperature of 46°.

At 10 p.m., on July 10th, a plate, which had been exposed on the lawn at 7.15 p.m. was found thickly dewed on the top, and still more thickly underneath. At 6.45 a.m. on July 11th a plate, which on the previous evening had been inverted and banked round with dry dusty earth on bare earth in a hayfield, gave 40 drops; a plate which had been on the lawn gave 98 drops. There had been a rapid fall of temperature down to a minimum of 40° at night; at 6.45 a.m. the temperature half an inch above the ground was 54°, at 13 in. below the ground 60°. This last had doubtless been practically constant during the night.

On July 28th there had been no rain since July 20th, and the surface of the ground was dry. On the previous evening, at 7.15, an arrangement of pans had been made in order largely to eliminate the condensing influence of radiation into space and of the accession of external air. A small earthenware pan about 3 in. in diameter was inverted on the grass, over this a plate, and over the plate a thick earthenware white dairy-pan of large size, $17\frac{1}{2}$ in. in internal diameter. At 7.20 a.m., on July 28th, the large pan was found nearly dry outside, but heavily dewed inside, yielding half a teaspoonful of water besides what remained adhering to the surface. The plate within was not

dewed outside, but heavily inside, giving 88 drops. The small pan within the plate was moderately dewed inside. But the most remarkable thing was this, that the grass inside every inclosure, even the last, was heavily dewed with drops, as on an autumn morning. The grass outside was moderately dewed where reached by the wind, thickly in sheltered places. The night had been fine on the whole, but at 7 a.m. the sky was clouded and there was a strong drying wind. The previous day, July 27th, was fine, with a hot sun and a fresh N.E. wind. The evening was fine, bright, and windy, with a little low scud and haze.

The temperature at the surface and at a little depth in the earth was as follows:

		½-inch above surface.		At ½-inch deep.		At 3 inches deep.
		°		°		°
July 27.— 6·30 p.m.	...	60	...	66	...	—
„ — 6.45 „	...	59	...	66	...	67
„ — 7 „	...	56	...	64·5	...	66
„ — 8 „	...	54	...	63	...	64
„ — 8·55 „	...	52	...	60	...	62
„ —10 „	...	50	...	59	...	60
July 28.— 7.30 a.m.	...	55	...	58·5	...	57

On July 28th the min. thermometer on the grass was wet with dew underneath at 9 p.m., and its upper surface at 10 p.m. At 7 and 8 p.m., and still more at 9 and 10 p.m., stones and pebbles lying on the dusty sand of the road were wet with dew on their lower surfaces, and many pebbles, even on the warm sand near the house, were quite wet underneath, where the ground was dusty. All were quite dry on their upper surfaces. Stones which were half embedded in the sand were moist on the under side, and had evidently, by their condensing action, kept the ground moist underneath them. Black stones of close texture, and pieces of slate lying on the sand, showed their wet surfaces best, but absorbent sandstones could also be seen to be moist underneath. An arrangement of pans, similar to that employed on July 27th, gave similar results on the night of July 28-29, and two tumblers on garden soil, which was dusty down to three-quarters of an inch and one inch, were found heavily dewed inside in the morning.

Surface and earth temperatures were as follows:

		½-inch above surface.		Just under short grass, half covered.		¾-inch deep.		3-inches deep.
		°		°		°		°
July 28th.— 8 p.m.	...	56	...	60	...	63	...	64·5
„ — 9 „	...	54	...	58	...	61	...	62
„ —10 „	...	52	...	56	...	60	...	61
July 29th.— 8 a.m.	...	52	...	58	...	58	...	56

On August 4th, 1892, and the morning of August 5th, when

scarcely any rain had fallen since July 20th, the temperatures of earth and grass were found to be as follows:

	Aug 4th. 7 a.m.	8 a.m.	5.50 p.m.	6.45 p.m.	7 p.m.	7.15 p.m.	8 p.m.	9.50 p.m.	10.50 p.m.	Aug. 5th. 7 a.m.	8 a.m
	°	°	°	°	°	°	°	°	°	°	°
½ in. above grass.	50	52	64	...	52	50	48·5	46	45	45	49
On grass.	51·5	54	66	54	54	50	50	47	47	48	50·5
Just under grass.	54	54	70	58	57	55	52·5	50	50	50	53
1 in. deep.	58	57	68	64	64	62	61	58	57	54	54
2½ in. deep.	58	...	70	66	65·5	64	62	60	58	...	...
4 in. deep.	58	...	...	...	...	...	...	...	...	...	...
9 in. deep.	...	57	...	...	...	...	...	...	...	56	...

A piece of glass exposed at an inch above the ground, over short grass, was found during the night and morning to be heavily dewed on the lower, not at all on the upper surface. Stones laid on sand and on grass were quite wet on the under side, dry on the top.

Since the minimum temperature on the night of August 4th and 5th was 38° over the grass, and since the temperature from one to three feet downwards may be taken without sensible error to be constant about 62° to 58° at this time of year, it follows that a difference of about 20° to 24° existed during the coldest part of the night between the air near the ground and the earth from 9 inches to 3 feet in depth; and that vapour coming from these levels towards the surface may have emerged at a temperature of about 46 or 47° at the coldest, and impinged against blades of grass at a temperature of only 38°. This difference of 8° or 9° is clearly sufficient during the night-time in the damp air close to the ground to cause copious precipitation on the grass. The difference between the temperature of emerging vapour and the air just above the surface may be quite as great in the sunset hour, but the surface may be too warm to permit so much deposition on itself, and the vapour with its contents consequently mixes with the air at some little height above the ground, becomes rapidly cooler, and often sinks into a misty stratum over low ground.

On August 5th, 1892, the following temperatures were observed in the several situations mentioned, the night being fine and nearly cloudless till about 11 p.m., when the sky became somewhat clouded:

	8 p.m.		9 p.m.		10 p.m.
	°		°		
Just under grass of lawn.........	54	...	52	...	50
1 inch under earth of lawn......	62	...	60	...	59
In field near western hedge, about 20 ft. lower than lawn: on grass	43	...	38	...	35
Ditto under grass	51	...	47	...	45
Ditto 15 inches in earth	62	...	62	...	62

The minimum on the grass in the field was 32°, and would probably have been as low as 29° if the night had kept fine and

clear. At 8 p.m. on August 5th the glass suspended an inch over the lawn was clouded with dew on the lower side only, and the stones on the dry grass and earth were very wet underneath, but dry on the surface. The above results showed a difference of temperature amounting to about 26° between the top of the grass and its roots in the coldest part of the night.

Many observations similar to the above were made during the summer, and led to the following conclusions: That a great quantity of vapour issues from the earth even in dry weather and where the surface is dry, and that the maximum emission, or at least condensation, on exposed objects, appears to take place in the hours of early morning in dry weather; that in summer about half, and at other times of year a large proportion of the dew formed is condensed vapour from the ground; that a considerable proportion is derived from the exhalations of grass and of plants generally; that soon after sunset in June, July, and August, the temperature of short grass and contiguous air may be 9 to 15 or 20° lower than that of the earth at a depth of 1 to 15 inches, and that about sunrise the temperature of the top grass of a pasture field may be 20 to 30° colder than that of the earth at depth of 9 to 15 inches and lower; that in hot weather about and after sunset, and in shady places before sunset, there is a very large emission of vapour from soil which may be dry and dusty on the surface; that in June, July, and August the temperature of the earth from 9 to 15 inches remains constant within a few degrees of 60°, but is lowest during the day and highest during the night.

It appears from observations made by Herr Singer at Munich during the twenty-nine years, 1861 to 1889, that at a depth of 4 feet 3 inches the maximum temperature of the year (59·3°) is reached on August 24th, and that at a depth of 19 feet 7 inches the maximum temperature (50·3°) is reached on November 17th.

Fodor's results gave an average maximum temperature at a depth of half to one metre in August, at a depth of two metres in August and September, and at a depth of four metres in October. Changes of temperature in the air, lasting a few days, take two or three days to reach a depth of half a metre, and then affect the earth only to a very slight degree. Liebenberg's observations show that sand is warmed throughout more rapidly than clay, and that the richer a soil is in organic matter the greater its power of absorbing heat.

As far as my observations go, the vapour emission at night through an upper layer of dry garden soil is very much less than through dry sand or dust. The vapour, with any particles which it may contain, is probably almost entirely arrested and absorbed by two inches of dry mould.

Sandy estuaries, beds of dried up torrents, and flats of sand containing organic matter, which are moist at a little depth below the surface, must emit quantities of air and vapour containing small organisms; these pass more easily through the sand than through the imperfect filters which baffled early experimenters. In hot climates, such as India and Italy, and on bare sandy ground, or in valleys, it seems probable that the differences of temperature between soil and surface air may amount at night to 30 or 40°, and in malarious places the flow of impure vapour towards the surface may be equal to the evaporation from an exposed marsh. In fact, there is reason for regarding underground beds of moist decaying organic matter, containing the organisms of malaria, diarrhœa, dysentery, or other disease, as often almost equally capable of emitting those organisms into the air through a covering of sand as if such a covering did not exist. There will be some proportion between the rate of emission and the differences of temperature, so that those places would *cæteris paribus* be most malarious where the differences of temperature between soil and surface air at night are greatest. This is I believe in accordance with experience.

Mr. Aitken states* that his experiments on cloudy condensation revealed the fact that there are enormous multitudes of particles so small that the concentrated light of the sun does not reveal them. Hundreds of these are crowded into every cloudy condensation of air. By a number of interesting experiments Mr. Aitken showed that bodies warmer than the air drive away dust from their surfaces, and create the dust-free black coat which surrounds them. He further showed that an evaporating surface has a similar influence, and that dust was driven more than twice as far from the wet part of an object as from the dry, the object being above the temperature of the air. In relation to the human body, and especially to the lungs, the evaporation in addition to the heat tends strongly to ward off dust and to keep it from coming in contact with the surfaces of the body. A temperature less than that of the human body was found very capable of preserving the surface from dust deposit. The necessary conditions for the repulsive effect to be strongly shown are, that the air be acquiring heat and acquiring moisture from the surface. Very little heat with moisture gives a thicker dark plane than double the heat would do. Mr. Aitken observes that the ease with which dust passes through small openings is surprising, indeed he has found that any opening which admits

* *Proceedings of the Royal Society*, 1877. Formation of small clear spaces in dusty air. By John Aitken.

air also allows these less than microscopic particles to pass. These observations have a bearing on the exhalation of vapour from the earth and the deposition of dew.

The layer of earth down to a depth of several feet is usually much warmer on fine nights than any objects such as grass, leaves, or stones within a few inches above the surface. In summer I have found the uppermost grass in the evening to be frequently from 8 to 12° colder, and sometimes 24° colder, than the earth at a depth of 4 inches, and generally to a depth of 12 inches or more. If the upper stratum be porous like sand, which incloses about an equal bulk of air, and if the earth below be moist, a large quantity of vapour must escape at night from the earth, bearing with it by its ascensional force many small solid particles. The surface of the earth will be giving off during the night a large quantity of air, vapour, and small particles, and these will come in contact with the cold surfaces of plants which are radiating to the sky. The conditions appear to be such as Aitken found highly conducive to the deposition of small particles. It is further probable that, in some situations, many living particles which have been carried up by the ascensional force of the vapour from the moist earth, float for a short time in the air within a few feet from the ground, and then, owing to their radiation and cooling, become weighted with moisture and fall slowly to the earth. The susceptibility to malaria at the sunset hour is thus easily understood. The warm earth or marsh is emitting great quantities of vapour and organic particles, these rise to a little height in the evening, and on their descent attach themselves to grass and other cold surfaces. After sunrise, the evaporation of dew thus pervaded with organisms, probably carries many into the air by its ascensional force, and if the morning be very still, there may be some danger from malaria after sunrise, but the general ascensional movement of the air prevents close aggregation.

A bare sandy surface enables the earth below to acquire more heat, and consequently to emit more earthy vapour at night, if the subsoil be moist, than a surface covered with grass. Moreover, the cold grass would intercept much of the rising vapour and organic matter.

It is generally assumed that evaporation or distillation of water gives rise to pure vapour and leaves behind all impurities, but this is not true with regard to minute organisms in some natural conditions. The upward movement of the air from drying ground, the bursting of countless small bubbles and films, the development of electricity in evaporation, the repulsion, as shown by Aitken, of small particles by a warming and evaporating surface, all help to carry into the lower air a large quantity

of ultra-microscopic and microscopic dust. Some of these influences probably also carry off from the lungs and air-passages of persons suffering from such diseases as scarlet-fever, diphtheria, and even consumption, the infective particles which, when sufficiently numerous, convey the disease in the air which has been breathed out. Thus walls on which the breath condenses may become culture-grounds for disease. A very small bubble of gas breaking on the surface of a glass of water is seen to scatter particles of water upward to a distance of several inches, and a similar scattering of water particles with the organisms contained in them can hardly fail to occur occasionally on mucous and earthy surfaces. The snapping force of a film of slightly soapy water about the millionth of an inch in thickness is great, sufficient to transmit an audible sound in the breaking. The impure and somewhat viscous water of drying marshes and of drying organic earth would certainly form many small films which, in breaking, would scatter their contents into the air. The blowing into the air of spray from the surf on the sea-shore in a storm, producing a driving mist of particles even to some hundreds of yards inland, is an illustration on a large scale of what occurs on drying marshes where the particles are beyond the range of visibility. In ordinary, and especially in sandy soil in a warm climate, the power of the vaporous current which passes into the air from the earth to carry with it organisms derived from a depth of less than an inch to more than two feet, can hardly be doubted. According to Parkes, some of Pettenkofer's observations show that a very large amount of air is contained even in firm soils, and that effluvia from decomposing substances may pass for a long distance through very loose soils. Soils which are permeable to water are of course still more permeable to air and vapour, and are generally permeable to small particles held in suspension in these gases. The permeable soils are sandstones, loose sands, and chalk, and are healthy unless either a clay stratum or a hard rock a few feet below the surface holds up the water, and unless the soil be contaminated by a large quantity of organic matter. Movement of subsoil water of course greatly affects the quantity of earth-vapour given off within certain periods. Some sands, such as those of the Landes in France, contain much organic matter. The dried beds of water-courses are well adapted for the evolution of malaria, for the superficial layer is often sandy and permeable, the soil contains much organic matter, and the water-level is not far from the surface. Similar conditions are found at the foot of mountains, but the upper soil may be either sandy or rich. The Terai, in India, a belt of country lying a little South of

the Himalayan range, is well known as especially subject to malaria.

Dr. Ballard has stated, with regard to diarrhœa, that the essential cause resides ordinarily in the superficial layers of the earth, and that on occasion the micro-organism concerned is capable of getting abroad from its primary habitat, the earth, and of finding in food, inside as well as outside the human body, nidus and pabulum convenient for its development. Diarrhœal mortality is high upon made ground and polluted soil, especially where it is water-logged and where the superficial layer is sandy and pervious. The one condition which gives exemption is the foundation of dwellings on hard and impervious rock. In the case of gravel, the nearer it approaches to sand in fineness the greater the prevalence of diarrhœa, where other conditions are equal. While diarrhœa was prevalent at Leicester Dr. Jenkins found two to three times as many microbes in the air in certain districts as before and after that period, and in the worst affected part, he found four times as many as in that which was least attacked.

There appears to be no doubt that tetanus is caused by a microbe very widely distributed in the superficial layers of soil. It was of very frequent occurrence among soldiers who lay wounded on Indian battle-fields, when hot days were followed by cold nights, a condition leading to large exhalation from heated ground.

Dr. Vivian Poore, in his address to the Institute in 1890, stated that the vegetable mould on the surface of the earth is very rich in saprophytic bacteria, whereas the subsoil at a depth of three to six feet is barren of bacteria, and he quoted from Flügge's work on micro-organisms the observation, that "infusions made from manured fields and garden earth, even though diluted 100 times, still contain thousands of bacteria in every drop, and the ordinary soil of streets and courts also shows the presence of large numbers. Bacilli are present in much the largest numbers, but in the most superficial layers and in moist ground there are also numerous forms of micrococci." There appears to be no reason why some varieties of organisms should not exist equally well in damp soil containing organic matter covered by a pervious and loose stratum. Certain conditions, such as a high level of underground water, the presence of filth and dead bodies, and a high temperature, seem capable of evolving organisms fit to attack successfully the living body. It is after the warm days and the warm season, that is, when the earth at a little depth is at the highest temperature, that malaria and several other diseases are most prevalent. The amount of disease and mortality caused by earthy emanations

exceeds in many countries that of all other causes combined. In India, and even in Italy, there are many places where the whole population is afflicted with life-long weakness and ill-health. In some of these a removal of the pestilent condition of the soil appears possible, in others a removal of the population to healthier situations may be the only practicable remedy.

In conclusion, I may be allowed to point out the bearing of the above observations on the importance of securing an impervious flooring and ventilation under houses and in tents, of paving in towns, of avoiding "made soils," and the vicinity of graveyards; of drainage of damp and organically-polluted soils, of widely separating cesspools from wells, and of preventing the exposure of articles of food and drink to night air near the ground.

Mr. G. J. Symons, F.R.S. (London), regretted the absence of Professor Lane Notter, who had presided in Section I. The parallelism between his remarks, respecting the generation of cholera in Northern India, and those of Mr. Russell was a curious instance of the universality of truth which cropped up now and then in such a way as to almost startle them.

The Chairman (Dr. W. J. Russell) remarked that Mr. Symons had mentioned a circumstance which did not appear in the paper just read—that Mr. Russell's interesting experiments were similar to those previously made by Mr. Aitken, and it was very satisfactory to know that the results obtained by both agreed. It showed that the theory of wells, although so firmly believed in up to the present time, did not embrace the whole question, but that the aqueous vapours which formed the dew came in larger proportions from the ground than from the air. Mr. Russell applied this and made his point very clearly, pointing out the importance which must arise from the great difference in temperature between the earth and the air above. This statement of his was very striking, as it showed what a very great amount of projective force might arise from this cause.

Local Geology from a Sanitary Standpoint, by W. Whitaker, B.A., F.R.S., F.G.S., Assoc.Inst.C.E., Assoc.Soc.Med.Off. Health.

By permission of the Director-General of the Geological Survey the new MS. six-inch maps of that Survey were exhibited, and these formed the text of the discourse. The work on these maps has been reduced on to the new one-inch map, sheet 331, the engraving of which is in hand and may be finished this year (1892).

A short account of the geology of the neighbourhood of Portsmouth was given, from the Drift beds to the Chalk, and it was pointed out that the former, though thin, occurred over a large area and had a marked effect on the shape of the country, forming flat ground at a low level.

The choice of sites for building on was discussed, and it was noted that one of the newest of the geologic deposits, the Alluvium, or marshland of streams and creeks, was a bad site, both from its extreme lowness and from its otherwise damp character. Nevertheless, in part of Southsea some houses had been built on such a soil, partly perhaps masked by made earth, and it was strongly suggested that the Corporation should not allow further building thereon, but should have such sites kept as open ground, houses so placed being likely to favour rheumatism as well as consumption. Satisfaction was expressed that some of the houses in question showed strong signs of giving way, from insecurity of foundation, and at the news that the Corporation were considering the matter.

The rest of the town, as well as the neighbouring town of Gosport, is built on the Drift, and chiefly on gravel. This deposit forms good building-sites, except when very thin and water-logged, giving both a firm and a dry foundation. The loam that often overlies the gravel may be somewhat less advantageous, but here it is both thin and rather sandy; moreover it is commonly worked off for brickmaking before building is begun, and the houses then rest on the gravel beneath.

The great question, however, in which the geology of the district has a practical bearing, from a sanitary point of view, is that of water-supply, and the sources of water around Portsmouth may be discussed under three heads:—The Gravel, various more or less permeable beds in the great series of Tertiary formations, and the Chalk.

The large sheet of gravel is a very permeable bed, and being

mostly underlaid by clays, must hold a great quantity of water. In the open country this water would naturally be of good quality, unless contaminated artificially; but where buildings are common the risk of contamination increases vastly and soon becomes a certainty. In parts that are well populated this source of water should be avoided, and any supply from it in the town should be closed.

The thick mass of Tertiary beds that underlies the Drift of Portsmouth and Gosport, and rises up from beneath the Drift northward, is for the most part clayey and therefore impermeable; but there are in it various beds of a more sandy character, which allow of the passage of water, more or less freely, the chief of them probably being the Bagshot Sand, some 30 feet thick. It is from such sources that sundry deep wells in the two towns get their supply.

The Gosport Water Works are a very notable case of a large supply being got from Tertiary sands. The wells and borings of these works, at Bury Cross, are of various depths, and they secure the water from the different sand-beds passed through, beginning at no great depth from the surface and going down to nearly 750 feet.*

Though Gosport gets a good supply in this way, the like could not be done at Portsmouth, the demands of which are far larger: moreover, should the population of Gosport increase very much, it may become a question whether the works there can be increased in proportion. Should this turn out to be the case, it is consoling to feel that Portsmouth can, of its plenty, spare enough for its near neighbour.

It is to the Chalk only that Portsmouth can look for its supply, and lucky, indeed, is the town in getting a bountiful supply of good water as easily as it does. In other cases the supplies of towns of less size have to be got by digging wells and by driving galleries far and wide; but here, in the first place, little more has to be done than to take what a kindly Nature provides. In the low ground near Havant the surface of the Chalk is in places a little below the level of saturation, or the level of underground flow of water. As a result, there are springs at such places; the water that was flowing underground on the north appears at the surface, and, from the plane of saturation rising northward, under the higher ground

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* Since the above abstract was in print (December, 1892), the author has heard that a boring at the Gosport Water Works has been carried down to the depth of 786 feet, the Chalk being reached at 777 feet, a greater depth than he expected, the Reading Beds being 127 feet thick, which is in excess of anything found before in the neighbourhood. No water was got in the Chalk.

in that direction, there is a constant flow of water underground to the sites of the springs. All that has to be done to get the water in great quantity is to open out the springs, and to keep the pools thus made clear of vegetation.

The amount of water yielded by the various springs at Havant and Bedhampton is undoubtedly very great; but it has often been vastly over-estimated, as much as 200 million gallons a day having been given as the yield. This, however, seems to be a romance, and it is doubtful whether a quarter of that amount is reached: as even this latter figure is nearly ten times as much as Portsmouth wants; the town may therefore be well content with sober reality.

Whether the whole of the water comes (directly, at all events) from the Chalk is a little doubtful; the hardness of the water is less than is usual with Chalk-water, and it seems possible that there may be communication with sands that occur in places near the base of the Tertiary Series. In this there is no harm, the lessening of the hardness indeed being an advantage.

There is, however, another chance of the mixture of other water with that from the Chalk. Around Havant there is a good deal of gravel, and the water falling on this would tend to flow toward some of the springs. As noticed above, water from such a gravel-tract, where there is a good number of houses, is likely to be contaminated, and it is essential that such water should be kept out of the works. It is satisfactory to know that this had not escaped the attention of the Company, and that the purity of their water had been ensured by puddled walls having been made well down into the Chalk, so as to cut off the access of surface-waters.

Having so good a supply, which is used not only for the town itself, but also for parts of the surroundings (including Havant), it behoved the authorities of Portsmouth to religiously preserve its purity.

Mr. J. H. Ball (Southsea) opened the discussion by asking for some information as to the springs which were to be seen near Havant. He lived close to Havant and had had the opportunity of seeing the great care that the officials of the Portsmouth Water Works took to exclude some of the water, at all events, which might be deleterious to the water supply. As architects they could not lay too closely to heart what Mr. Whitaker had said about unsuitable sites for building, and he would specially like to hear something as to the insecurity of foundations in water-logged soils, caused by subsequent drainage. It was a point often seriously neglected, and one or two such cases had occurred at Portsmouth. It would be

very useful if they could get any data about the amount of foul water which a given soil would absorb, and over what area a given amount should be distributed.

Dr. J. Ward Cousins (Southsea) warmly protested against any insinuation that the water supplied to Portsmouth was in any way contaminated.

Dr. J. Groves (Carisbroke) said the hint thrown out with reference to the Portsmouth Water Works was very important. People absorbed ideas slowly in the South, and though there might not be much said about it now, the possibility of contamination would be much talked of a week hence. He thought that if the protecting wall were not deep enough the chalk-water might be contaminated by that from the gravel, into which Havant had been drained. It was, he feared, very common in this part of the world, in places where they did not care to go to the expense of getting water from the chalk, to draw the supply for drinking purposes from the gravel into which the filth was discharged; leaking cesspits were sunk in the gravel from which the water was drawn. There was another point that was important and must not be lost sight of. In a place like Portsmouth, for generations past, the sewage had been discharged into the gravel, and if wells were left, the water of which was not objectionable to the taste, and looked nice, there was great protest against closing them. He did not know whether there were any wells left in Portsmouth, but it was so in other parts of England. In London, during the cholera epidemic of 1866, the Privy Council gave the medical men in charge of the districts instructions to close the wells, and he was astonished to find so many wells in use in the Strand district. They had to close what was known as the "holy well," in Holywell Street, and there was a great fight over that. The inhabitants continued to pump from the well until the pipe was taken up. After the lead pipes had been removed he went down and examined this well and actually found a drain emptying into it which he cut off. Subsequently he discovered that this drain communicated with a closet into which cholera stools were thrown. Cholera poison would have found its way into the "holy well" if they had not cut the drain off when they did, and if the well had not been closed cholera would have been distributed far and wide, for people sent long distances to the "holy well" for their drinking water.

Mr. H. R. Smith (Engineer to the Portsmouth Water Works Co.), referring to Mr. Whitaker's remarks anent the Company's springs at Havant, said that as there might be a suspicion that some reflection had been cast on the water supply he would state that the possible danger referred to had been anticipated by the Directors, and it was impossible that there could be contamination in the way suggested. There had been a sentiment outside that it might be possible for water from the Tertiary beds to get into the chalk springs, and two

or three years ago the Directors spent many thousands of pounds in building a puddle-wall, which in some places reached to a depth of thirty feet, being everywhere continued into the chalk and not merely to a uniform depth of six feet as had been stated. During the excavations for this wall there was very little water indeed seen passing through the Tertiary beds, and that proved how small a quantity came into the springs. The subsequent report of Sir Robert Rawlinson on the subject after the puddle-wall had been completed, stated that it was impossible now or in the future for any water to come from the upper strata into the springs. As a matter of fact the water came from a very deep seat and was the same in temperature all the year round—it was about 50° or 51°, winter and summer, night and day. The Company had spent thousands of pounds in acquiring land and protecting their works, and there was not the slightest ground for any suspicion whatever of the entrance of any impurity.

Mr. W. Whitaker (Southampton) replying, said with reference to the Havant springs that they were only a like occurrence, in another place, to the springs from which the Water Company got its supply, but they were at a higher level, in the valleys of the Chalk hills. The underground water-level of the Chalk springs rose inland, and varied roughly according to the level of the ground. The high Chalk country was intersected with valleys, and here the Havant springs, which were known by a host of names, occurred when the level of saturation rose above the levels of the valley-bottoms. He asked Mr. Ball, or any others interested, to record the times of outbreak, where they occurred, and all about these springs, because records of them were very interesting. The water-levels of the wells near the Havant spring agreed exactly with them. Mr. Baldwin Latham, a member of the Institute, had taken such careful observation of similar springs that he was able to predict on what day and where they would break out.

The settlement of buildings he could readily understand. If a big sewer was made it might bring half the houses down because it drained all the water out of the gravel, and in buildings near, the result would soon be disastrous; many years ago he had seen that in making a sewer near Victoria Park (London) a small water-pipe was broken in the gravel, and if the outflow had been allowed to go on a little while longer the result would have been a subsidence of the neighbouring houses.

The question, how much water the soil would absorb, wanted a great deal of investigation. When firm rocks were concerned it depended largely upon the form of rock and its position; with loose soil it was hard to form an opinion. Sometimes such a soil would absorb nearly as much as one liked to put into it.

Of course there was a possibility of the contamination of Portsmouth water, as there was the possibility of contamination of every water under the sun; and there must be in Portsmouth lots of out-of-the-way places where cesspits had not yet been discovered,

and which would do harm to any water obtained, except from the Water Company, and except, perhaps, from the wells in big works and breweries, whose water was as well protected as that of the Water Company. In the area in the Strand, where the Law Courts stand, were found wells such as Dr. Groves had described, and under one was discovered a coffin! There was a good deal of body in the water of that well. He had noticed in many country places, too, that there were "Holy Wells" in which the water was supposed to be particularly sanctified, close to the churchyards. He did not cast any reflections on the Portsmouth water; he only said that having got a good supply they must take care to keep it good. As to Mr. Smith's arguments, he (the speaker) only wished to point out that a small amount of water might come in from the older Tertiary sands. Chalk-water came up into the Tertiary sands sometimes. In London, in the Chalk wells, it was sometimes found, by chemical analysis, that the water was not all Chalk water, but that it was mixed with water from sand. Of course the line of junction between the gravel and the Chalk would be irregular, and naturally the reservoirs at the Portsmouth Water Works would vary in depth accordingly. The temperature of the water was a good test as to when the water was from a good spring and not simply one trickling into the Chalk from some other overlying deposit.

What he meant to say about the Gosport Water Works was that they were a good example of catching water from Tertiary sands; of the two he should prefer the Portsmouth well. As regarded the Portsmouth supply he did not wish it to go forth that he had spoken the least ill of it; he only thought they were lucky to get it so easily, and he believed that the Water Company would look well after the interests of the consumers. He was glad to find the Company supplied places outside the Municipal district.

The President of the Section (Dr. W. J. Russell), in conveying the thanks of the meeting to Mr. Whitaker, said that even those who had no personal connection with Portsmouth had, he was sure, listened with much interest to this paper, and those who had a local interest in the town must have been particularly interested in what Mr. Whitaker had told them.

On "Entomology as a Sanitary Science," by THOS. B. GOODALL, F.R.C.V.S.

I AM not aware that the study of Entomology has been deemed of sufficient practical importance to give it a place in sanitary science, though we shall be able to show that the services of the engineer and of the chemist are brought into requisition only because man has of necessity been compelled to dispense with the services of Nature's proper scavengers and purifiers, the larvæ of many dipterous and coleopterous insects.

We have many excellent works on injurious insects; and in the study of Entomology it is of common occurrence to read of the larvæ of certain insects being found in dung, in decomposing vegetable or animal matters, or in drains or ditches or stagnant water; but I do not know of any work having been written to connect these with the great question of sanitation, or on those Diptera which are eminently beneficial to the health of mankind.

It will be my object on the present occasion, by giving a brief resumé of the life-history of two of the Diptera, or Flies (though there are hundreds that are concerned in scavenging work), to draw the attention of sanitary scientists to a study, a knowledge of which will be serviceable on some occasions.

In approaching this subject, we must be reminded that man has elected to oppose his will to all the laws and forces of Nature; and that civilization induces a condition in which the primary laws of Nature are set at defiance and disorganised. Man says that these violations are all necessary for his well-being and comfort.

In venturing on such a step, how little does he consider that Nature's laws cannot be violated with impunity; that if one small link in the vast chain of the cycle of life is destroyed, or its functions materially interfered with, it necessarily leads to the disarrangement of other links. If one is destroyed we must immediately wage war with its compensating balance.

Let us bear in mind the fundamental principle that every form of life is created for a purpose, and is absolutely necessary to effect the changes that are for ever taking place in the infinitude of particles, that together make up "matter."

In Nature, stagnation is impossible, but there is a constant, ever recurring growth and decay.

Nature provides a vast army of workers whose office it is to disintegrate all particles that have formed part of an organised being.

Inorganic matter is for ever being converted into organic, by the infinitude of forms of life of the vegetable kingdom; this is

taken to a higher grade through the vegetable to the animal kingdom, and all this same "matter" has to be as constantly re-converted to the inorganic world again, that it may be renewed; this is done by the action of the most minute forms of known life.

This we might designate a rough outline of the "main stream of life." But just as a great river has thousands of uses and functions, besides just running its course, these being, in fact, the purpose of its existence, so has this "main stream of life" thousands upon thousands of functions to perform, and the well-being of every form of life, from man to monad, is dependent upon its rhythmic course.

If any form of life threatens to become superabundant, Nature's laws make ample provision for checking excess, or the balance to be interfered with.

It is at this point where the sanitarian might take a useful lesson from the laws of Nature. All his ingenuity and skill is taxed to prevent excess in the numbers of the bacteria and the micrococci, &c., or the microbes, ferments, and moulds, because he knows that they are his deadliest foes in the struggle for existence.

Nature does not allow these disease germs, or putrefactive germs, or death germs, to run rampant; we must bear in mind that from Her standpoint they are, within certain limits, as necessary for the rhythmical flowing of "the stream of life," as are any of the other forms of organisms, animal or vegetable; and Nature has made ample provision for checking their superabundant increase. This is, without doubt, due to the action of the myriads of larvæ of hundreds of forms of dipterous and coleopterous insects; but civilized man, with his closed sewers and drains, prevents these insects depositing their ova in his sewerage and refuse; the microbes are protected, and increase *ad infinitum*. Man shuts away their natural enemies, and, by breaking the cycle of "the stream of life," places himself in antagonism to Nature's laws; and having as it were refused the aid of Nature's forces, he must exert his utmost vigilance by an unceasing constant use of disinfectants, &c., to keep the numbers of his minute foes in check.

When we spread manure over the land it teems with microbes, but we find insects innumerable depositing their ova in it, so that their larvæ feed on the microbes; we cannot walk abroad in any rural district, with our eyes given to search, without realising this truth. Wherever there is decomposing organic matter, there shall we find swarms of those insects, whose larvæ live, not on the matter itself only, but also on the microbes which cause its disintegration.

And now, gentlemen, if your patience is not utterly exhausted, I must defend the propositions I have laid down by demonstration. This I shall do by taking you briefly through the life-history of two most useful scavengering diptera, and explaining to you what I have myself observed of the methods of their larvæ in procuring their food.

One of the most useful is the *Eristalis tenax*, or Drone fly. In its perfect state it has some resemblance to the hive bee, and the female is to be seen frequenting the margins of vessels containing putrefactive organic matters in solution; about stagnant ditches, sewers, drains, or manure yards; here she deposits her ova into crevices above the water-line. The larvæ on leaving the egg pass into the dirty water or mud, and they can live in either.

Specimens may be found in any drain, cess-pit, or in any place where there is decomposing organic matter in a state of solution.

When the larva is mature it leaves the water, buries itself in the earth, the outer skin forms the puparium, and in this the pupa is transformed to the perfect insect or imago again.

It is the larvæ to which I particularly wish to draw your attention, and I submit to you one or two drawings I have made from life to exhibit the points of most importance.

The mouth proper is retractile, being enveloped by a series of folds of the anterior segments of the body, that we might designate lips; these folds are studded by numbers of re-curved hooklets, which appear to be protruded and retracted with the movement of the folds, like the claws of the cat. These folds have a two-fold function: when the creature is feeding among solid matters they are used in drawing the food to the mouth proper; when it is suspended in the water, they, with the assistance of other organs which I shall refer to presently, act as cilia, inducing a current of the filth-impregnated water to flow towards the mouth, which enables it to select its food.

Proceeding from the centre of the inner part of the membranous folds are two bifid claws, which can be turned back towards the mouth; these may be organs of prehension when necessary; they are also used in locomotion, being protruded, they lay hold of the ground surface, and the body is drawn along. Surrounding the oral orifice are a number of fibrillæ, and on each side of it is an organ having much the appearance of the gill of a fish.

The oral orifice is very small indeed, and it is probable that all food has first to pass these fibrillæ and gills; following the mouth is a hard-looking organ, the gizzard; it is hard, rounded, and in two lobes, a passage being seen down its centre—this is in one piece with the mouth, being drawn forward with that organ as the folds and prehensile organs retract.

Proceeding from the gizzard are two indistinct tubes communicating with a large gland on each side of the body, secreting glands of some kind, and the stomach proper follows, of a saccular shape across the body; then follow two other glands and the large intestinal convolutions leading to the anal opening. This is surrounded by a large fan-like organ, which is only protruded when the creature is undisturbed, and of which there is no visible sign under the microscope. When the animal is feeding this is in constant motion like the opening and shutting of a hand, and there is generally a string of fœcal matter seen protruding from the anal orifice at its centre.

It has six pairs of membranous feet, and each of these has on it a number of sharp-looking claws.

The breathing apparatus is also very remarkable, and fits it admirably for its mode of life, being, as it must be, enveloped in filth.

The posterior abdominal segments are protruded in the form of a tail and can be extended to several inches, the extreme end of this is hard and chitonous, and at its extremity are two hair-like pieces. Proceeding up this elongation are the two air tubes, opening at the extremity and passing down to a large air-sac on each side of the body. In a large larva these are nearly as long as the body, but in a very young one, as the one from which my sketch is taken, they are relatively much smaller. From these air-sacs tubes proceed to the anterior segments of the body, and one is always noticed in the folds at each side of the mouth. These become the spiracles in the pupa. When the creature is feeding in a fluid medium it hangs with the end of the tail protruding through the surface of the water, the folds of the segments surrounding the air tubes are extended and contracted by muscles which can be seen. The fan at the posterior part of the body is in constant motion directing a current towards the mouth, and the make of the pedal appendages assists this action. The folds surrounding the mouth are in a constant state of opening and closing, drawing minute particles suspended in the water towards the oral orifice. As the folds dilate the mouth and gizzard retract; as they close in again this is protruded, and this action is almost continuous.

The creature will also take particles of semi-solid food, but *not until* it is in a state of putrefaction.

To test this I placed a dead larva with a living one in a clean vial of water. It took no notice of its presence for 36 hours, when it suspended itself in the usual attitude for feeding, and by a patient use of its prehensile organs, and the hooks of the folds surrounding the mouth, it made a way through the

external skin, and splitting it open as it went on, it devoured all the soft internal structures and left the hard skin. I contend that it did not attempt to do this until its dead companion was disintegrated by putrefactive organisms, and then it demolished these.

Can we doubt then that this is in nature one of our best and most useful scavengers. Its breathing apparatus adapts it to keep itself supplied with a large quantity of air when enveloped in filth, from which it is ingesting those organisms, which would otherwise be multiplied to excess, and make the locality uninhabitable for man and the higher forms of life.

Another very useful little creature in its larval stages, to man, is the *Culex pipiens*, the common gnat. Anyone not conversant with the life-history of this fly is likely to exclaim at this assertion; in fact, by the generality of people it is looked upon as an unmitigated nuisance, and we hear people saying that it has no use in nature but to torment man and beast! But in what a different light do we regard it when we know all about its life history.

The eggs are deposited by the female on the surface of stagnant water, and, for choice, she prefers water containing decomposing organic matters. I have kept two tubs of water side by side, freely exposed to the air; in one of them the water was teeming with organic matter, and in the other it was kept clean, the gnats deposited their ova only on the water containing the filth, the other was left untouched. The eggs, 500 in number, are agglutinated together by the female into a boat-shaped little black mass, which floats freely over the surface. After about twenty-four hours the ends resting on the water open, after the manner of the operculi of mosses, and the little creatures immediately commence their lively aquatic life.

These rough drawings show how beautifully they are adapted for the performance of their function as scavengers. I would have you notice that they cannot ingest solid matters as such, but they can freely partake of the microbes swarming in the situations in which they are found.

As the creature hangs suspended with the point of the "tail" protruding through the surface, it is breathing, for the spiracles, two in number, pass through this, and the large air reservoirs are seen passing from this through the length of the body, plentiful small branches of the air tubes going close to the mouth and its appendages.

The mouth parts are most beautifully ciliated—my drawing can convey only an imperfect idea of this—but as it hangs suspended, or when it is feeding at the bottom of the vessel, these

cilia are seen to be in constant motion, creating quite a current of water towards the small oral opening; and from this it selects all those smallest of creatures on which it feeds. It seems to be partial to the microscopical algæ, but it will thrive in any water containing putrefactive organisms.

The oral opening seems to be guarded by a kind of sieve, and then we see a hard-looking gizzard, and then the stomach proper, followed by a large digestive tract well marked; and this by smaller convolutions, which are rather indistinct, and terminating through the anal opening, which is situated at the extremity of a second prolongation of the posterior abdominal segments, quite independent of the one through which the spiracles pass. I need not weary you by taking you through the other stages of these insects, my object being only to show those facts which seem to indicate that a knowledge of Entomology might be useful to the Sanitarian.

Another gnat, the *Chironomus plumosus*, deposits her eggs as a spiral mass held together by a glutinous secretion, after the manner of a frog. These may be seen on the edge of a vessel containing stagnant water, being generally fixed to the side and hanging in the water, being very easily mistaken for annelids, or worms.

The larvæ of these are known as blood worms; they are also quite as useful as the others I have named.

Then, too, a study of the larvæ of the common "blow-fly" (the *Calliphora vomitoria*) and its allies would repay the Sanitarian.

There are hundreds of other dipterous insects, amongst which might be mentioned the common house-fly, *Musca domestica*, the Stinger, *Stomoxys calcitrans*, the small Phoridæ, &c. A study of the life history of each of which would be equally as interesting and instructive as the one or two I have been dwelling on more particularly; and as their larvæ are also found in decomposing organic matters, if we admit that the function of the myriads of these dipterous larvæ is to keep in check the numbers of the putrefactive organisms, we shall be bound to acknowledge that the magnitude of their operations in the economy of life is stupendous.

In the great rush of life we seldom pause to consider how great are the works being accomplished by these small scavengers of Nature, but some idea of their numbers, and the consequent vastness of the work of their larvæ may be formed, when I tell you that on a warm summer's evening I have driven nine miles and have been passing through swarms of gnats the whole of the way.

I have but touched the fringe of a vast and important subject,

but if I have said sufficient to arouse the interest of such an important body as The Sanitary Institute I shall be satisfied.

But surely the brief facts I have laid before you point a lesson to the rural sanitarian at least, that he should not be so ready with his closed drains and sewers, to hide all refuse out of sight, and then make the public and himself believe that they are safe. The putrefactive and disease inducing organisms are not by this means shut off from the organic matters which it is their function to restore to the elements; but being thus protected from their natural enemies, they multiply inordinately, and when they escape from their pent-up drain pipes, as they must do periodically, man and his domestic animals pay the penalty of his folly in disturbing Nature's equilibrium.

What appears to be the most rational method of sanitation, and the one most conformable to the rules of "the great stream of life" is that all fœcal and organic matters, in rural districts, be removed as far as practicable from dwelling houses and wells, and spread over the land. If offensive, they should be covered with a light coating of earth, and then Nature's myriads of workers would be enabled to perform their allotted tasks, and we should be saved the sufferings of many evils, and much expense.

I was at a gentleman's mansion a few days ago, where the sewage was run into open ditches. I was taking notes for this paper. The ditches were low, ducks and fowls were feeding on the very larvæ I have been describing, the *Eristalis tenax*. Here the cycle of life was being completed. Putrefactive organisms disintegrating the sewage matters, the larvæ of the Diptera had been thriving and growing on them. The ducks and fowls were growing fat on these larvæ, and would in their turn be consumed by man.

I only lay these notes before you as being applicable for the disposal of ordinary normal sewage. The bodies of all animals having died of an infectious disease should be either cremated or destroyed chemically, and all fœcal matters from diseased man or animals should be treated in the same way.

Dr. J. Groves (Carisbroke) remarked, that their great object was to keep the water supply pure, but in order to do so he thought they could not trust altogether to the little scavengers Mr. Goodall had described. He had very much to do with such matters in rural districts, and found that frequently the people drained into leaky cesspits, because they would not be at the trouble of emptying them; the cesspits practically drained into the drinking well, and he would like to know how to introduce those little things into the water so that the germ of typhoid fever might be eaten up. That would be a practical application of the lesson to him as a Health Officer.

Dr. W. G. Black (Edinburgh) pointed out that they could see the sanitary work done by the insect world every day. The ordinary dung beetles (*Geotrupes Stivenarius*) did good scavenging work, and there were also the carrion insects, *Necrophorus* and *Staphylinus*, which were constantly found on carcases, and one of which was the burying beetle. He thought the common house fly, however, was a great disseminator of diseases, such as Ophthalmia in Egypt, and the mosquito and bug maliciously disturbed hygienic repose.

Mr. T. B. Goodall (Christchurch), in reply to the question concerning drinking water, said that if the dipterous larvæ he had been describing were found in a sample of drinking water, it would be fair evidence that it contained putrefactive organisms, for the female flies deposit their ova *only* on such water; and if water was so contaminated by sewage, it would be the duty of the Sanitary Officer to keep the sewage out. He simply wished to enforce the lesson of what was being done by the little creatures he had described. In country districts the most rational way of getting rid of the sewage was frequently neglected; they wanted to destroy it in an elaborate manner, but by so doing they were impoverishing the land. He could have mentioned many other insects that were doing good sanitary work; there were hundreds that were so employed, but in his curtailed paper he had simply touched the fringe of the subject to raise an interest in it. He mentioned that he had watched a pair of Sexton beetles bury the body of a dead mole, in a sandy soil in less than four hours; and he alluded to the manner in which the common Dung beetles carry into the earth excrementitious matters. The house fly had been described as a disseminator of disease, by biting and innoculating, but it was not so, for the mouth of this fly was so constituted that it could not pierce the skin. There was a fly very much like this (the *Stomoxys*) though it was not the same—the mouths of the two were very different—the *Stomoxys* could pierce the skin, whereas the house fly could only suck up moisture from the outside of the skin. When people blamed the house fly in that way it showed that they had not studied the anatomy of its mouth. Whatever little harm might be done by this adult insect, was compensated a thousand-fold by the beneficent sanitary work of its larvæ.

The President of the Section (Dr. W. J. Russell) said he thought that Mr. Goodall had accomplished what he desired in trying to raise an interest on a subject which was of considerable importance. They were not in the habit of realising how great was the amount of work carried on by these insects, but were inclined to attribute the changes to purely chemical decomposition. At the same time Mr. Goodall did not advocate their giving up precipitation and other means of purifying sewage, and introducing these animals instead. People in general began to tremble and wonder that they lived at all when they heard so much about microbes, but it was reassuring to know that there was so much good fighting being done on their behalf. He tendered the thanks of the meeting to Mr. Goodall for his paper.

"*The Determination of Dissolved Organic Matter in Water*," *by* W. C. YOUNG, F.I.C., F.C.S., &c.

IN making an examination of water for sanitary purposes, one of the most important things to be determined is the quantity of organic matter in solution. Until recently there has been no reliable process available which would give the required information with any degree of accuracy.

The processes relied upon by analysts for ascertaining the organic purity of water are the following:—

1. Loss on ignition of the solid residue.
2. Frankland and Armstrong's combustion and other similar methods.
3. Wanklyn and Chapman's Ammonia method.
4. Oxygen absorbed from potassium permanganate.
5. Wanklyn's moist combustion method.

The "loss on ignition" method (the only direct process of the five) has been almost entirely abandoned on account of its untrustworthiness, but as it is even now used by several chemists, I have included it with the others. The figures obtained by it, when every precaution is taken, are always very excessive, the reason being that a portion of the loss sustained by the mineral constituents of the residue through the high temperature employed is included in the results.

The following figures show how great the error is:—

	Grains per Gallon.								
	1.	2.	3.	4.	5.	6.	7.	8.	9.
Total organic matter in solution	·105	·245	·140	·210	·300	·308	·350	·560	·750
Loss on ignition of solid residue	0·8	2·6	1·6	5·6	1·4	9·4	2·4	3·6	6·8

The organic matter in solution was obtained by myself by a process to be described later on, and the "loss on ignition" by another chemist from duplicate samples.

Frankland and Armstrong's "Combustion" method is not in general use, probably on account of the complicated character of the apparatus required, and length of time taken by it, and possibly because of the variable results obtained upon the same waters by different chemists.

Frankland claims that this process accurately determines the quantity of two of the constituents, carbon and nitrogen, of the organic matter in water. He claims further that the proportion of carbon to nitrogen shown by the results obtained indicates the nature of the organic matter, as the proportion of carbon to nitrogen is much higher in vegetable than in animal organic matter.

If these claims could be substantiated the process would undoubtedly be very valuable, and, short of giving the exact amount of organic matter present, nearly all that could be desired.

The process is used by Dr. Frankland and the Companies' analysts for ascertaining the organic purity of the water supplied by the London Water Companies, and the results are published in monthly official Reports, both of which are embodied in the monthly Reports of the Metropolitan Water Examiner.

If the process possessed the accuracy claimed for it, the results obtained by Dr. Frankland should differ little from those obtained by the Companies' analysts, and although the samples of any one of the Companies' water analysed by either may possibly have contained a little more or less of organic matter, the organic matter must have had a constant composition, therefore the proportion of carbon to nitrogen should be practically the same in each case.

In the following Table I have placed side by side the proportion of carbon to nitrogen shown by Dr. Frankland and the Companies' analysts in their monthly Reports on the London Water Companies' water during the year 1889. This year was not selected for any particular reason, but simply because, at the time the Table was prepared, it was the only year of which I possessed a complete set of the Returns. I have since compared the Returns for the subsequent years and find a similar result.

TABLE showing the proportion of Organic Carbon to Organic Nitrogen in the results of Analyses of Water supplied by the Metropolitan Water Companies, by Dr. Frankland and the Companies' Analysts for the year 1889, *taken from the Monthly Official Returns of the Metropolitan Water Examiner.*

Name of Water Company.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.	
	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.	Company's Analysts.	Frankland.
	C : N	C : N	C : N	C : N	C : N	C : N	C : N	C : N	C : N	C : N	C : N	C : N	C : N	C : N	C : N	C : N	C : N	C : N	C : N	C : N	C : N	C : N	C : N	C : N
New River	4·3 : 1	3·4 : 1	3·9 : 1	4 : 1	4·4 : 1	2·9 : 1	4 : 1	4 : 1	3·7 : 1	7·6 : 1	4 : 1	3·1 : 1	3·6 : 1	2·8 : 1	3·8 : 1	3·7 : 1	3·4 : 1	2·3 : 1	4·1 : 1	5·3 : 1	4·5 : 1	4·5 : 1	2·6 : 1	3·5 : 1
East London	3·3 : 1	5·8 : 1	3·2 : 1	5·7 : 1	3 : 1	5·1 : 1	3·1 : 1	4·6 : 1	3·1 : 1	6·3 : 1	3·3 : 1	5·1 : 1	3·3 : 1	5·8 : 1	3 : 1	3 : 1	3·1 : 1	4 : 1	3·2 : 1	6·3 : 1	3·5 : 1	4·9 : 1	3·4 : 1	3·8 : 1
Chelsea	3·4 : 1	5·7 : 1	3·4 : 1	6·9 : 1	3·3 : 1	5·1 : 1	3·1 : 1	4·8 : 1	3·2 : 1	7·2 : 1	3·1 : 1	5 : 1	3 : 1	3·6 : 1	3·1 : 1	4·5 : 1	3 : 1	4·4 : 1	3·1 : 1	7·7 : 1	3 : 1	4 : 1	4·1 : 1	4·2 : 1
West Middl'sex	3·4 : 1	6·1 : 1	3·3 : 1	5 : 1	3·4 : 1	5·6 : 1	3·3 : 1	4·1 : 1	3·1 : 1	6·2 : 1	3·2 : 1	4·1 : 1	3·3 : 1	5 : 1	3 : 1	4·3 : 1	3 : 1	4·9 : 1	3·1 : 1	6·6 : 1	3·4 : 1	5·4 : 1	4 : 1	4·7 : 1
Lambeth	3·3 : 1	4·3 : 1	3·5 : 1	4·4 : 1	3·4 : 1	4·4 : 1	3·2 : 1	4·7 : 1	3 : 1	7 : 1	3·3 : 1	3·3 : 1	3·1 : 1	4·6 : 1	3 : 1	5·1 : 1	3·1 : 1	4·5 : 1	3·1 : 1	6·3 : 1	3·4 : 1	4·5 : 1	4 : 1	4·8 : 1
Grand Junction	3·5 : 1	4·6 : 1	3·3 : 1	3·6 : 1	3·3 : 1	2·6 : 1	3·3 : 1	3·3 : 1	3 : 1	5·1 : 1	3 : 1	3 : 1	3·2 : 1	4·5 : 1	3·3 : 1	3·6 : 1	3·1 : 1	4·8 : 1	3·1 : 1	6·5 : 1	3·3 : 1	5·4 : 1	3·5 : 1	4·8 : 1
S'uthw'rk and Vauxhall	3·4 : 1	4·7 : 1	3·4 : 1	6 : 1	3·3 : 1	4·1 : 1	3 : 1	4·6 : 1	3 : 1	5·2 : 1	3 : 1	2·7 : 1	3·3 : 1	3·8 : 1	3 : 1	4·8 : 1	3·1 : 1	3·6 : 1	3·1 : 1	9·9 : 1	3·3 : 1	5·9 : 1	3·5 : 1	5·2 : 1
Kent	3·9 : 1	3·4 : 1	4·6 : 1	2·2 : 1	4·3 : 1	2·4 : 1	3·1 : 1	2 : 1	1·7 : 1	4·5 : 5	4·7 : 1	9 : 1	4·5 : 1	4·2 : 1	5·5 : 1	3·3 : 1	11·3 : 1	3·1 : 1	9·5 : 1	4·9 : 1	3·6 : 1	4·7 : 1	3·4 : 1	2·2 : 1

It will be seen from this Table that with very few exceptions Dr. Frankland's results differ greatly from the other, and show a much higher proportion of carbon to nitrogen. It will also be observed that Frankland's results are much less uniform than those of the Companies' analysts, the proportion of carbon to nitrogen varying from 2·3 to 7·6 to 1 in the New River; from 3 to 6·3 to 1 in the East London; from 3·6 to 7·2 to 1 in the Chelsea; from 4·1 to 6·6 to 1 in the West Middlesex; from 3·3 to 7 to 1 in the Lambeth; from 2·6 to 6·5 to 1 in the Grand Junction; and from 2·7 to 9·9 to 1 in the Southwark and Vauxhall Company's water.

According to these figures, the organic matter in the samples examined by the Companies' analysts was almost invariably of a totally different character from that in the samples examined by Dr. Frankland. It seems also that the organic matter in Frankland's samples was of a much more variable composition than that in the samples examined by the Companies' analysts. The actual analytical results show many striking differences. In the New River Company's water the Company's analysts found more than twice as much organic nitrogen as Dr. Frankland in July, November and December, and nearly twice as much in May. The organic carbon was also three times as much in July, and more than twice in November.

In the East London Company's samples the Company's analysts' organic nitrogen results were nearly three times higher than Frankland's in October, more than twice in May and August, and nearly twice in January, February, June and September.

In the Chelsea Company's water the Company's analysts' organic nitrogen results were more than twice those of Frankland in May, July, August and October, and nearly twice in September. Their organic carbon was also nearly twice that of Frankland in July.

In the West Middlesex Company's water the Company's analysts' results were more than twice those of Frankland in May and August, and nearly twice in June, July, September and October.

In the Lambeth Company's samples their analysts' figures for organic nitrogen were more than twice those of Frankland in May, July and August, twice in March and April, and nearly twice in June and October. Their organic carbon was also nearly twice Frankland's in June.

In the case of the Grand Junction Company's water, their analysts obtained more than twice the quantity of organic nitrogen than Frankland in May, June and July, twice the

quantity in April, and nearly twice in February, August, September, October, and November. Their carbon results also were more than twice as much as Frankland's in June, and twice in April.

In the Southwark and Vauxhall Company's water the Company's analysts found more than twice as much organic nitrogen as Frankland in February, May, July, August and October, and nearly twice as much in September, November and December. They also found nearly twice as much organic carbon as Frankland in July.

The analysts for the seven Companies alluded to were Mr. Crookes, Dr. Odling, and the late Dr. Tidy, and great as are the differences shown between their results and Dr. Frankland's, they are small compared with the discrepancies in the analyses of the Kent Company's water; the Company's analyst in this case being the late Dr. Bernays.

Dr. Bernays found more than three times as much organic nitrogen as Frankland in July, more than twice as much in March, June and December, twice as much in January, February and April, and nearly twice as much in May and November. On the other hand, Dr. Frankland found five times as much as Bernays in September, and twice as much in October. Dr. Bernays also found four times as much organic carbon as Frankland in February and March, more than three times as much in July and December, three times as much in April, and more than twice as much in January.

It will be seen also, by the table, that the proportion of carbon to nitrogen varies enormously in both Dr. Frankland's and Dr. Bernays' analysis of the Kent Company's water, ranging in the former's from 2 to 9 to 1, and in the latter's from 1·7 to 11·3 to 1.

The enormous differences in the actual results obtained with this process by eminent chemists having extensive experience of it, upon the same waters show that the claim of accuracy is not sustained, and as the proportion of carbon to nitrogen in the organic matter differs so frequently the process is seriously misleading in its indications as to the quality of the organic matter.

I cannot, within the limits of this paper, discuss the cause of these discrepancies, but must point out that even if the process were perfect in every respect it would only account for the non-volatile organic matter, as the volatile (which is present in water in considerable quantity, as I have shown in my paper on the subject, read before the Society of Chemical Industry in November, 1891) is lost in the evaporation.

Wanklyn and Chapman's "Ammonia" method of analysis is

most extensively used by chemists. It professes to distinguish between vegetable and animal organic matter by the relative proportions of "free," and "albumenoid" ammonia obtained by the process. The results may be absolutely relied upon to give certain indications of the presence of *fresh* sewage pollution, and of the degree of contamination, but when the pollution is not recent it fails to distinguish between animal and vegetable organic matter. In such cases it is necessary to supplement the process by determining the quantity of chlorides and nitrates present, when, if the results are abnormally high, there need be no hesitation in coming to a definite conclusion that the water has been subject to sewage pollution at some previous date. The following analyses illustrate the application of the process:—

No. of Sample.	Grains per Gallon.			
	Free Ammonia.	Albumenoid Ammonia.	Chlorine as Chlorides.	Nitrogen as Nitrates.
1.	None.	·00035	1·12	·437
2.	None.	·0014	·77	·437
3.	·0007	·0014	1·68	·875
4.	·0056	·0028	4·34	3·06
5.	·0322	·007	3·64	1.1

All the above samples were from wells in the same locality. Nos. 1 & 2 represent the normal condition of the water in the neighbourhood, and are unpolluted. No. 3, although safe organically, gives evidence by the increase in the chlorine and nitrogen as nitrates, of having at some previous date been polluted by sewage. No. 4 is of first-class quality, judged by the small quantity of "albumenoid" ammonia obtained from it, but as it is associated with a larger proportion of "free" ammonia there appears to be a slight recent contamination by organic matter of sewage origin, and the large quantity of chlorides and nitrates further indicate that there has been a considerable sewage pollution in the past. No. 5 shows, by the comparatively large quantity of "albumenoid," the still larger quantity of "free" ammonia, and the high results for chlorides and nitrates, that the water is contaminated by recent sewage pollution of considerable extent, and also that the pollution has been in existence for some time.

The process has been found exceedingly useful by innumerable chemists, and gives fairly concordant results with duplicate samples of water in the hands of different operators, but as the albumenoid ammonia bears no definite relation to the quantity

of organic matter present it affords no means of estimating the proportion of the latter.

The "oxygen absorbed from potassium permanganate" process was originally suggested by Forchammer, and subsequently modified and improved by Miller, Tidy, and Dupré respectively. The process, in the improved forms suggested by Tidy and Dupré, is largely used as a confirmative test, but its indications cannot be relied upon as in any sense a measure of the organic matter present, therefore it is of very little use. The following examples show how contradictory its results are:—

No. of Sample.	Grains per Gallon.	
	"Oxygen absorbed" (Tidy's Method).	Total organic matter in solution.
1.	·006	·140
2.	·006	·300
3.	·018	·308
4.	·073	·350
5.	·042	·750

Wanklyn's "Moist Combustion" method is not very much used, probably because it was patented by its author when first introduced. It is really a modification of the last-mentioned process, the difference being that the permanganate is used in the presence of an alkali instead of an acid, the oxidation is carried on at boiling temperature, the water is concentrated, by distillation, to a tenth of its bulk during the process, and a much larger quantity of the water is employed.

The process appears to me to be very promising, and its author claims that the results are roughly proportionate to the quantity of organic matter present. Whether this is so or not I am unable to say, as there are no experimental results available upon the point.

Having dealt with the several processes in common use, showing how little they can be relied upon for estimating the exact quantity of organic matter in water, I now direct your attention to a process, which has been in constant use in my laboratory for more than two years, giving perfect satisfaction, by which the volatile and non-volatile organic matter in water can be determined, together or separately. I may here remark that volatile organic matter in water has been entirely overlooked hitherto, and I need hardly point out that it must be of equal importance, at least, with the non-volatile.

The process was first introduced in my paper on the subject, read before the Society of Chemical Industry in November,

1891, and for full details I refer you to the Journal of the Society, Vol. X. p. 883.

Shortly described, the process is as follows:—

To determine the Total Organic Matter.—1 litre of water, to which 0·5 gramme of dried and ignited sodium carbonate is added, is distilled in a conical iron still of about 2 litres capacity, attached by means of a gun-metal "swan's neck," with screw connections, to a tin worm condenser. The distillate is received in a graduated measure, and when 970 c.c. has been collected, the heat is removed, the still disconnected, the contents and washings placed in a platinum basin and evaporated to dryness on a water bath. The residue is then dissolved in a little pure distilled water, filtered through an asbestos plug into a platinum basin, dried on a water bath, and subsequently heated for an hour in an air-bath, at 150° C. After cooling in a good desiccator, the basin and contents are weighed in a quick balance. The residue is then ignited at a low temperature (below red heat), cooled and weighed, and the loss noted. The ignited residue is then dissolved in water, excess of dilute sulphuric acid added, and standard solution of potassium permanganate (1 c.c.=·0001 gramme oxygen) added, until the colour is permanent after five minutes. The weight of oxygen lost by the reduction of nitrates in the residue thus ascertained is deducted from the loss on ignition, and the difference is the organic matter.

To determine the fixed or non-volatile organic matter the same course is followed, except that the sodium carbonate is not added until the concentrated water is transferred from the iron still to a platinum basin.

To determine the volatile organic matter the distillate from the last-mentioned process is placed in the still together with 0·5 gramme of sodium carbonate, and distilled until about 25 c.c. remains in the still, afterwards proceeding as before, except that it is unnecessary to ascertain the quantity of oxygen lost on ignition. The result represents about two-thirds of the total volatile organic matter present; further small quantities can be recovered from the distillate by repeating the process.

The process gives only the *quantity* of the organic matter in water, and does not afford any direct evidence of its *quality;* still, when there is a large quantity present the odour given on heating enables a fair opinion to be formed as to whether it is of animal or of vegetable origin, but I am bound to say that I find it quite impossible to decide in this way when only small quantities are present.

The depth of colour of the concentrated water appears to be roughly proportionate to the organic matter present. By

making up the bulk of the liquid, before the last evaporation, to, say, 10 c.c., and comparing the colour, as seen in a small flat-bottomed glass cylinder, with a standard, a good idea may be formed of the quantity of organic matter present. A good standard colour may be prepared with weak ammoniacal solutions and Nessler's reagent, which when once ascertained can readily be reproduced.

The process is extremely simple in practice, requires little personal attention and can be completed within four hours.

In conclusion I give a few illustrations of its application to different classes of water, together with results obtained by other processes, for comparison.

Description of Sample.	Grains per Gallon.						
	Fixed Organic Matter.	Volatile Organic Matter.	Total Organic Matter.	Free Ammonia.	Albumenoid Ammonia.	Oxyyen Absorbed. (Tidy's Method.)	Chlorine as Chlorides.
Moorland Water	·385	·315	·700	·0028	·0021	·070	0·63
Do.	·420	·280	·700	·0021	·0028	·073	0·70
Water from the New Red Sandstone	·105	·280	·385	None.	·0014	·003	1·05
Chalk Well (deep)	...	...	·350	·0014	·0007	·047	1·15
Do. do.	...	...	·490	None.	·0007	·021	1·54
Do. do.	...	...	·130	·042	·0042	·013	1·82
Source of River Lee............	...	...	·511	·0007	·0042	·040	0·98
Do. do.	...	...	·560	·0007	·0035	·0157	1·05
Source of the New River ...	...	...	·693	·0021	·0035	·040	1·26
Do. do. ...	...	...	·420	·0007	·0028	·0177	1·40
River Lee. Intake of New River	...	...	·441	·0014	·0035	·0268	1·05
Do. do.	...	...	·308	·0014	·0049	·0232	1·26
River Lee. Intake of East London Water Co.	...	...	·483	·0056	·0056	·0484	1·40
Do. do.	...	...	·385	·0042	·0063	·0490	1·40
Kent Water Co..................	·273	·140	·413	...	...	...	...
New River Water Co.	·175	·280	·455	...	...	...	...
East London Water Co.	·322	·210	·532	...	...	...	...
West Middlesex Water Co....	·420	·140	·560	...	...	...	...

Dr. H. W. A. Sandell (Leighton Buzzard), referring to the differences in analysis, said that it was mentioned at the Conference of Medical Officers on the previous Tuesday by more than one speaker that different results had been obtained in analyses of water taken from different levels in the same well.

Dr. J. Groves (Carisbroke) corroborated this remark, adding that it was a point that had not occurred to men generally, but which was

of the greatest interest. Dr. Thresh stated at that meeting that he had noticed a similar difference in analysis of water taken from a tube well.

Mr. J. H. Ball (Southsea) asked whether there was any simple but reliable way of testing the purity of water.

Dr. J. Groves (Carisbroke) said that unfortunately while a chemical analysis would prove the presence of contamination, it would not prove its absence. The poisons which would be potent in producing disease may be present in drinking water, but chemical analysis may not detect the presence of impurity. The source of supply and its surroundings were the true tests of the wholesomeness of water.

Dr. F. Pearse (Southsea), in answer to a question, remarked that without a chemical analysis it was impossible to say whether the organic matter present was of a vegetable and comparatively harmless nature, or whether it was animal matter.

Dr. J. Ward Cousins (Southsea) said that the very best common test of the purity of water was to find its source and its temperature. An analysis of water required great skill, and elaborate chemical apparatus, and it was impossible to have a common test such as Mr. Ball had suggested, though taste might sometimes be a guide.

Mr. J. H. Ball (Southsea): If Dr. Cousins had seen some of the water I have, he would not have ventured to taste it.

Dr. J. Ward Cousins (Southsea): Then there could not be much doubt of what the result of analysis would be in such cases.

The President of the Section (Dr. W. J. Russell) admitted that one of the great necessities of the times was some simple test to decide whether water was wholesome and fit to drink or not. It was a very natural request, and one that was often made to chemists. His own impression was that no such thing existed or was likely to exist. As long as people ate high game they could drink water that contained a good deal of decomposing organic matter. The chemist could not answer the question whether it was a wholesome water or not, but he could say whether the water was likely to become dangerous, and whether it was contaminated by sewage matter or not. It would be a great advantage were there a simple test, but there was not. He hoped that the method described by Mr. Young might be thoroughly relied upon, because it would give them a great deal of additional information as to the character of a water. It was simply a refinement of the old test of burning off the organic matter and reweighing. He regretted Mr. Young's absence, but thanked him for his paper.

On "A method of determining the purity of stable air by a comparison of the temperature within and without the building," by Veterinary Captain F. SMITH, M.R.C.V.S., F.I.C., Professor in the Army Veterinary School, Aldershot.

ABSTRACT.

THE examination of the air of a large number of stables, has shewn that the sense of smell carefully employed gives a fair idea of the amount of impurity present, as was demonstrated by the late Dr. de Chaumont to be the case in barrack rooms.

The carbonic acid of two or three hundred specimens of stable air was determined, and during the course of these experiments some observations were made as to the difference between the temperature of the external air and that of the stable.

I found that, as a rule, the greater the impurity of the air, the greater the difference between the temperature of the air of the stable and the air outside, so that by observing the thermometer, a fairly correct estimate could be obtained of the air purity of the building. A difference in temperature of from 3° to 5° Fahr. always accompanied air pollution; in the best ventilated stable the temperature of the building was only ·5° to 1° Fahr. higher than the outside temperature.

The above observations were all made during the winter, and at night time to ensure the stable being full.

When we remember that the warming of stable air is derived from the bodies of the animals which live in it, we can understand the *rationale* of the observation.

CONFERENCE OF NAVAL AND MILITARY HYGIENISTS.

ADDRESS

BY

INS.-GEN. J. D. MACDONALD, R.N., F.R.S.

PRESIDENT OF THE CONFERENCE.

Having been requested by the Council of "The Sanitary Institute" to act as President of the Conference of Naval and Military Hygienists, it devolves upon me to open the business of the Conference with an address on Hygienic matters. But, as the subject is wide and far reaching I must be satisfied with the consideration of some few important particulars, which I am led to hope will be of interest to those who may not have had precisely the same opportunities of investigating them. I always feel both proud and thankful to have been the friend and colleague of the late Professor Parkes at Netley, up to the date of his lamented death. One of the last things I submitted to him was a paper on the microscopic organisms detected in samples of ground air obtained on the spot. Up to that time the chemical constitution of the ground air had been investigated to a certain extent, particularly the increase of carbonic acid in proportion to the depth, but, no results of microscopical examination had been recorded. He gave me the sage advice not to make any public statement of the matter until I had amply supported my position by further experiment and proof. In passing I might say that the additional proof has been obtained, opening up quite a new field of research.

The ground air, like the ground water, is a subject of great importance, and has very largely claimed the attention of hygienists during the last few years. It is subject to its currents, storms, and calms, like the atmosphere above it, and though always more or less impure, it may be poisoned or infected with the products of specific organisms, as well as with the organisms themselves. Passing from this to the question

of drinking-water, I desire especially to call your attention to a persistent cause of its contamination in the play of the vital functions of the *Protophyta* and *Protoza*. But, for the more satisfactory comprehension of this interesting subject, it will be necessary to premise some general principles and then show their application in the particular cases adduced. In the first place, we know that gases, liquids, and solids tend, or may be made to intermix homogeneously by the exercise of attractive and cohesive forces, which are ever restless until an equilibrium is established. Simple as this statement is, it forms the basis of at least three important laws, viz.:—(1st) The diffusion of gases; (2nd) the osmosis of fluids; and (3rd) the dialysis of crystalloidal substances, the same affinities being exercised with or without the interposition of a medium. The first law manifests itself most strikingly, in the preservation of the same formula of composition in the atmosphere all over the globe. The second is perhaps best seen in the circulation of the sap of plants, and the third in the processes of deposition, and absorption in animals. The three great laws are each brought into activity under special conditions, and pressed into the service of Nature to fulfil by physical agency certain offices in the organic world, which were formerly supposed to be of a purely vital character.

Time would fail us in the attempt to give even a very cursory sketch of the numerous purposes subserved by these laws, but the subject of *Osmosis*, and of *Dialysis* in particular, as applied to the physiology of nutrition in the lower orders of plants and animals, may profitably engage our attention for a short time.

1. The materials of which organised bodies are composed are capable of either crystallization or are non-crystallizable, named respectively crystalloidal and colloidal substances, by Dr. Richardson, whose simple and intelligent view of the subject will answer our purpose admirably.

2. Crystalloidal substances are usually found in the fluid state, scarcely ever assuming the crystalline form, except under morbific conditions, and they will exhibit this tendency in the inverse ratio of their solubility. Thus, we find crystals of cholesterine in atheromatous deposits, carbonate of lime in the coats of the minute cerebral arteries and lithate of soda in gouty concretions, which owe their segregation and subsequent persistency to the absorption of the water with which they were originally thrown out from the capillary vessels. Besides the *Raphides* in plants, crystals also as such are to be found in some animal bodies, as in the *Thalassieollidæ* for example.

3. Colloidal substances, on the other hand, are found either in the liquid or plastic state for the growth and repair of the tissues, Albumen, Fibrine and Gelatine in the muscles,

Albumen particularly in the nerves and brain, and Gelatine in connective tissue, ligament and bone.

4. In the vital fluid, blood, both crystalloidal and colloidal bodies are homogeneously blended together in watery solution. The latter components take up water from the former and so continually yield it up again by transpiration, that a regulated supply of water is necessary to keep up this cycle of actions and preserve the fluidity of the circulating mass.

5. The late Professor Graham first demonstrated that crystalloidal substances will pass through a colloidal membrane floating on water and diffuse themselves through the latter, while colloidal substances also present are left behind on the dialysing membrane. In this way the poisonous alkaloids are usually isolated from the other contents of the stomach, and identified by their appropriate tests in medico-legal investigations. Now the walls of the blood-vessels are literally dialysing membranes, and the facts to which we have alluded shed much light on the physiology of absorption, deposition, nutrition, and secretion. It will be part of my purpose to-day to show that the extraordinary pseudo-volitional movements of certain minute algals, more particularly *Bacterians*, *Oscillatorians*, *Diatoms*, and *Desmids*, are due to the play of the same forces. In my work on the "Microscopical Examination of Drinking Water," I have endeavoured to show that a similar explanation will apply even to the pseudopodial extensions of the *Rhizopoda* and the gliding movements of the *Gregarainæ*, which are destitute of cilia.

The law of intermittency observable in the phenomena connected with assimilation and decay is most interesting, and quite in the same category as that which we notice in the circulatory, respiratory and digestive functions of animals in general. The first appearance of the germinal vesicle and spot in the ovum, its final dissolution, and the substitution of two new cells in its stead, afford us the earliest evidence of that intermittency of action or interchange of building up and breaking down which is to all living things an essential condition of existence. In further illustration of the principle I am advocating, I wish to refer you to the anatomy of the lower division of animals. In the naked eyed *medusa* for example, four great vessels radiate from the central somatic cavity to the corresponding generative organs nearer the margin of the disc, to and from which parts the current of blood intermittingly flows. Thus, the materials of growth and development are conveyed to the ovaries one moment, while the products of decay are carried back by the same vessels the moment following. The circulation in the Brachiopod (*e. g.*, *Lingula*) is even more remarkable, for,

although it also is effected by ciliary motion as in the *Polyzoa*, the out-going and returning currents course along the opposite sides of the same vascular channels.

The first unequivocal heart occurring in that well-marked series of beings which culminates in the true *Mollusca*, is found in the *Tunicata*. But here, as the circulatory system is in effect single, without any valvular mechanism, the whole round of the circulation sweeps alternately in opposite directions. Thus, the vessels conveying blood to a particular part one moment carry it back the next, when the course of the circulation is reversed. It is obvious therefore, that each vessel must play the part of artery and vein successively, affording another good instance of intermittency in those functions connected with the supply of new, and the removing of old material.

A perfect heart, with a receptive and a propulsive chamber, so arranged as to determine an irreversible path to the circulation, and the persistent distinctiveness of arteries and veins, distinguishes the *Mollusca proper* from the *Molluscoida* and *Cœlenterata*, to whose blood vascular systen allusion has been made. Organic cells, whether they appertain to plant or animal, are nourished in the same way, practically speaking, and while the singular movements exhibited by *Bacteria* and *Diatoms* are clearly due to invisible *Dialytic* or *Osmotic* currents, their obvious remittency bears out the views expressed in the foregoing remarks.

For many years after the publication of the great work of Ehrenberg on the INFUSORIA, while numerous unequivocal plants were eliminated from that *omnium gatherum* of organic forms, the *Diatoms* and *Desmids*, perhaps solely on account of their apparently volitional movements, remained in a doubtful position. They were constantly adduced in evidence of that neutral ground in which the animal and vegetable kingdoms were supposed to blend with each other or take a common origin. Indeed, the same may be said of the *Bacteria;* even the name of the putrefactive *Bacterium termo* was chosen to express the ultimate limit of animal life. At the present time, however, no doubt on the one hand can be entertained as to the vegetable nature of these forms or the absence of true volition in their movements on the other. Though these latter have not been hitherto satisfactorily accounted for, one remarkable fact has been observed in relation to them, namely, that when the energy by which the organisms move in a given direction is exhausted they forthwith pursue an opposite course, and this intermittency is continued indefinitely. Thus the normal movement of a *Diatom*, a *Navicula*, for example, is either zig-zag or backwards and forwards on the

same line, as we shall presently see. But the kind of movement unquestionably depends upon the shape of the frustule, a fact which does not appear to be recognised by writers, who deal with the subject in a general way. Thus, if the form is elongated or boat-shaped, as in *Navicula*, the movement will be in the line of the longitudinal axis, but if the form is short or irregular a wabbling movement will be observed. The movement of a true *Bacterium* is excursive, while that of a *Micrococcus* is a jostling dance, due to the special form and the interchange of actions in the minute parts of the protoplasm. In Flügge's great work, translated by Mr. Watson Cheyne, page 159, he states that "some vegetative forms and species of *Bacteria* are always at rest; thus the spherical cells and all those species which occur only in the form of *Micrococci* exhibit only a trembling movement, with very slight alteration of position, which may be referred to unavoidable agitation and currents," which latter remark appears to show that he did not apprehend the true cause of the movement itself or of its peculiar character. Indeed, on page 558 he remarks that "The movements of *Fission Fungi* are swimming movements in fluid media, and are generally or always produced by cilia," a very doubtful position. But, to return, it is now well known that if *Diatomaceous* frustule in its onward movement meets with an obstruction, it will naturally appear to contend with the difficulty, and in due time of course recede. Thus, the very fact which was at one time best calculated to support the volitional theory is shown to be deceptive. If we divide a frustule of *Navicula* into two parts by an imaginary line through its short diameter, each half will probably contain a considerable mass of endochrome and a highly refracting globule, much resembling that which we observe in the *Thalassicollidæ*, and which probably discharges a similar office. Now, to understand how movement takes place, say to the right, we have only to suppose that the right half of the frustule is taking up endosmotic currents, while exosmosis is going on in the left half. The former would, as it were, draw it to the right, while the latter would impel it in the same direction, but when these conditions are reversed the frustule will move to the left, or, in other words, the little ship will take an opposite course in the trackless field of the microscope. *Bascillariæ* executing their fantastic compound movements, and even *Oscillatorians* waving like cilia on a magnificent scale, fall into the same category.

When we come to study the numerous minute forms of *algæ*, both marine and aquatic, we find either that, the individual cells or definite groups of them are enveloped in a more or less consistent gelatinous substance which acts as a dialyser or medium

through which the materials of their nutrition are absorbed on the one hand, and the waste or effete matters of the organism are thrown off on the other. The gelatinous envelope in many cases takes so characteristic or definite a shape as to have obtained for it the name of a frond. It is sometimes beautifully laminated or dichotomously branched, globular or simply expanded floating or encrusting. The ordinary *Bacterium termo* and its allies which are individually surrounded with gelatinous matter either free, or clustered in the Zooglæa form, carry on their vital functions in a similar way; and it is incontestable that not only the matters which form their pabulum, but those effete compounds resulting from the waste of their substance, are in perfect solution in the surrounding water. Now, if we suppose only the waste materials or any part of them to be gaseous, they would first be held in solution up to the point of saturation, and then overflow or pass off into the surrounding air. There is great reason to believe that the subtle principles which may be assumed to be the cause of the most serious forms of specific disease are quite inodorous. In this light the more offensive gases have been regarded as the heralds of warning, either forbidding our approach, or demanding their own extinction, that in like manner more dangerous emanations may be either avoided altogether or divested of their power by the means employed in the first instance to correct a disagreeable odour.

The gelatinous coat of *Bacteria* and *Micrococci* varies much in its consistency under different circumstances and may even undergo complete solution.

It is apparently precipitated by chloride of lime, cupralum and some other disinfectants, including also the *Bacteria*. I can not be very certain, but it seems to me to disappear under the action of carbolic acid so far as to liberate the *Bacteria* and give them a more equable distribution over the field of the microscope. Now, it must be remembered that although colloidal substances in a concentrated state will not dialyse, they will do so when largely diluted, just as they would commonly occur in drinking water admitting for a moment their solubility. I mention this merely as another possible source of water contamination, that may not hitherto have been taken into account by Hygienists.

On "*The Prevention of Common Diseases at Home and Abroad*," *by* RICHARD DOMENICHETTI, M.D., Deputy Inspector General, H.P.

ABSTRACT.

IN regard to the prevention of diseases at home, the means at our disposal, although for the most part of a satisfactory character, are in some instances permissive and not obligatory, which is much to be desired. The powers of the Sanitary Authority, for instance, in dealing with the isolation of infectious disease require to be better defined.

Too much of the routine to be followed out by Medical Officers of Health is hampered with "red tape," and more latitude should be given to them in combatting epidemic disease. It is a mistake to expect that all Local Authorities will be guided by the experience and advice of those who should be in a position to enforce what is good for the interests of the community. Much may be said about the method of dealing with diphtheria and cholera, which have been discussed at some length in this paper.

Then as regards the prevention of disease abroad the author deals with the subject as presented to him during a long service in India and at Gibraltar, especially urging attention to the water supply and sanitation generally as being the only safeguard against attacks of epidemics unhappily still met with at the present time, though statistics and recent experience show how much has been done to disarm epidemic disease of its terrors. Allusion has been made to the diminution of the death-rate at Louth, Lincolnshire, where for 20 years the author has been Medical Officer of Health; the urban population, 10,000, has now a death-rate of 16 per 1,000.

"*On some sources of Danger to the Public Health in Indian methods of Conservancy: especially with reference to the prevalence of Zymotic Disease in that country.*" By Surgeon-Captain R. H. FIRTH, A.M.S., Assist. Professor of Military Hygiene, at Netley.

ABSTRACT.

INDIA is one of the few places which affords practical sanitarians an opportunity of seeing, on a large scale, the working of a dry earth system of sewage disposal. In that country practically

no other system is in use, and on the whole it is found to work satisfactorily. Notwithstanding this there are dangers in its too perfunctory employment. These dangers seem to exist in the fact that much of the soil in India, especially during the hotter and dry months, is impotent for producing those real and necessary changes in the excreta, which are the very essence and *rationale* of the earth method of sewage disposal. The author, in the course of a long series of experimental observations upon the nitrifying powers of various samples of Indian soil—taken not only from fields, but also from the earth supplied for use in barrack and hospital latrines—found that 14 per cent. of the soils failed to show any nitrifying power. Sandy soils, and the peculiar sandy and very dry soils of Upper India, appeared to be peculiarly defective and unsuitable for the conversion of excreta into harmless matter.

Another source of danger to public health exists in India in the absence of sufficient care being exercised in the manner of burying excreta. This carelessness is not the result of any want of special instructions on the point, but is the outcome of inadequate supervision and inspection. It is no infrequent occurrence to find that the excreta, instead of being buried in trenches at least one foot deep, are barely buried at all, or perhaps only just covered by a few inches of light, porous, sandy soil. This state of affairs is aggravated by the foraging propensities of pariah dogs and jackals after garbage and filth of all kinds—to say nothing of the denudation which follows the churning up of superficial soil by the dust storms so prevalent.

Complementary to this aspect of the subject is the seasonal prevalence of enteric fever in Upper India, which prevails chiefly in the hot dry months before the rains, and again in the drying up months after the rainy season. While desirous of not being thought to consider that all or one-half the cases of this disease in India are due to defects in the disposal of excreta, the author is yet of opinion that an appreciable number owe their origin to the diffusion, in the form of atmospheric dust, of spores and bacilli of that disease derived from imperfectly buried typhoid dejecta.

A further source of danger lies in the fact that it is no infrequent occurrence to find that the very cart which carried excreta out of cantonments for burial, is employed on the return journey to bring in dry earth for use in the latrines: while this very earth so brought in is often collected from spots where excreta have only recently been cast or superficially buried. Knowing as we do that Eberth's bacillus retains its vitality in soil for many months, such procedure is eminently

calculated to keep up a constant supply of the specific virus of typhoid fever in cantonments and elsewhere.

To remedy this condition of laxity in sanitary supervision and methods, the whole Sanitary System of India needs to be overhauled: with the establishment of definite Sanitary circles. These circles need to be judiciously limited in area, so as to be efficiently worked by a competent Sanitary officer. This officer should be a medical man endowed with full control over the subordinate Sanitary officials, and himself alone directly responsible to the executive government for the sanitation of the circle under his care. Further, those tracts or areas devoted to the reception of excreta need to be systematically cultivated and irrigated, so as to secure the necessary changes in the buried dejecta as well as a chemico-mechanical fixation of all hurtful elements within the deeper soil layers. The burning of all excreta should be encouraged as much as possible, as fire is the only agent on which we can rely for the destruction of disease germs contained in dejecta.

CONFERENCE OF MEDICAL OFFICERS OF HEALTH.

ADDRESS

BY

PROF. C. KELLY, M.D.

PRESIDENT OF THE CONFERENCE.

The census returns of 1891 show some remarkable results. The population of England and Wales, as estimated to April, 1891, amounted to 29,704,068, while, as enumerated, the actual numbers were 29,001,018, a difference of 703,350 persons.

The decennial rate of increase was 11·65 per cent., against 14·36 in the previous decade, and it was lower than in any previous intercensal period.

The natural increase of population amounted to only 3,630,761, whereas it would have been 3,919,543 had the increase been in the same proportion as it was in the preceding decennium. This was due to a steady fall in the birth-rate which has been going on continuously since 1876, when it was at its maximum. It was lower in 1890 than in any year during the last half-century, and it was 5·8 per 1,000 less than in 1876. This decline cannot be accounted for by a decrease in the marriage rate, and it will probably be found that in a considerable section of the population large families are not so often met with as in former periods. It is a fact well worthy of notice that whereas the death-rate for 1881-90 was lower than in any previous decennium, yet the diminution in the birth-rate was much greater, so that the loss in numbers due to the falling off in the births amounted to 288,782.

A second cause of the decline was due to an increase in the number of emigrants over immigrants. Had the balance of emigrants been in the same proportion in the last as in the previous decade the decrease would have been only 189,614, whereas it actually amounted to 604,182, or an access of 414,568. These two deficiencies account for the error of 703,350 in the estimated as compared with the enumerated population. Of the emigrants 410,648 were males and 193,534 were females; and although the ages of these people cannot yet be given, there can be little doubt that they include a large number of young adults at the active and productive period of life. The excess of males over females who leave the country

causes a large increase in the proportion of females to males at home; this increase has steadily gone on since 1851, and now there are 106·4 females to every 100 males.

There are in this country 900,000 more females than males, a fact of much importance when the competition for existence is so keen.

This excess of females is confined to urban districts; in rural districts the males are slightly in excess of the females, while in the urban districts there is an immense difference.

The erroneous estimates of population affect urban much more than rural districts. The twenty-eight large towns with a population of 9,405,108 had an estimated excess of 605,318; while in the rest of the country, with a population of 19,595,910, the estimated excess was only 98,032.

The estimates of the population are based upon the hypothesis that the rate of increase prevailing during the period 1871-80 had been maintained during the last decade. This method is untrustworthy, for in the case of the twenty-eight large towns the rate has varied from 28·3 per cent. to 11·2 per cent. during the last ninety years; and since the estimates have been wrong, it follows that the recorded birth-rates and death-rates have in most cases been given in error. In London the population was over-estimated by 271,255 persons; in Liverpool, by 103,327; in Salford, by 52,307; and in Nottingham, by 39,555. On the other hand, Newcastle was under-estimated by 22,486, and Portsmouth, by 15,457.

In the first or second year after a census the error is not great, but it increases rapidly towards the end of the decade; and during the last five years of an intercensal period the estimates for large towns are in most cases very misleading.

Mr. Noel Humphreys has shown that in Liverpool, on the old estimates, the death-rate had declined from 26·7 in 1881 to 23·6 in 1890, whereas the actual figures show it had risen from 26·8 to 27·8; in Salford the error was still greater; on the old estimates the death-rate was 22·6 in 1881, and 22·4 in 1890, whereas the actual figures show that it had risen from 22·7 to 27·6 per 1,000.

These are the most extreme examples, but it is very important for us to consider what can be done to prevent such errors in future. It is useless to prepare annual reports and to spend much time and labour in working out birth-rates and death-rates when the estimates on which we rely are so misleading.

We talk of lives saved when we really mean deaths postponed.

A low death-rate is not the only thing for which we should strive. A high wage-rate is just as important as a low death-rate.

In rural districts the population increases very slowly, and in

many counties it shows a decline. There is the same exodus towards the large towns as there was when Arthur Young wrote his surveys, and when Cobbett bewailed the growth of the Great Wen. The figures for each parish are not yet published, and there seems to be no reason for the delay. In 1881 the results were known a few weeks after the census was taken, but last year an instruction was given that no information should be granted to the public by those engaged in the census taking.

In rural districts the superintendent-registrar is very often the clerk to the sanitary authority, so that the medical officer may be giving his authority for erroneous birth-rates and death-rates for his district, while the clerk has in his pocket the correct figures, which he cannot disclose. There seems to be no good reason for this secrecy, for the corrected returns differ very slightly from the results sent in by the registrars, and as the public pay for the census-taking, they ought to know the main facts as soon as possible. If every superintendent-registrar sent in to each sanitary authority the summarised results for each parish at the same time that they were sent in to the census office the chief facts would be known within a month instead of having to wait for a period of two years. Any corrections hereafter to be made would hardly affect the birth-rates or death-rates.

The general public believe in a low death-rate as a sign of a healthy district, but this belief will be shaken unless more nearly correct information can be given. The errors at the next census-taking may be greater than those recently recorded, because emigration appears to be on the increase, and the returns on this subject are very imperfect. If young adults leave the rural districts for large towns or for other countries, there must be an accumulation of older people in our villages, and this raises the death-rate, while it is made slightly higher by the presence of so many males in the population. The age and sex distribution of a rural district may raise the death-rate 2 per 1,000, as compared with a standard population.

On the other hand the excessive proportion of females in large towns and the smaller proportion of aged persons tends to lower the death-rate, so that as compared with a standard population a recorded urban death-rate may be 3 per 1,000 below the corrected death-rate.

No one can view with satisfaction the results of the last census. We can speak of a lowered death-rate, but a declining birth-rate has had the effect of more than neutralising any increase in numbers from that cause. The increasing numbers of the young and active who emigrate, the excessive proportion

of females in our large towns, and the admission of pauper aliens are not elements which add to our prosperity.

The care which is taken of the idiot, the pauper, the lunatic, and the criminal may do credit to our humanity, but it does not add to the strength of a nation. To a great extent we are cultivating the weeds in our garden. In the great social questions which lie before us these facts must be taken into account.

It has often been urged that a quinquennial census should be taken, and this is now done in France and Germany, and in some of our colonies. There is a great need of a simple population enumeration every five years, which will give the correct numbers of males and females in each sanitary district, and the ages at which they live. The results should be published as early as possible after the census taking, while every ten years, as at present, more elaborate results could be obtained, which would be useful for actuarial purposes.

The returns of emigration and immigration should be more accurately given, and the age and sex of each person should be recorded.

There should be a statistical department established at the Local Government Board, so that men trained to the use of statistics may each year give nearer estimates of the growth or the decline of towns and country districts than we can at present obtain.

This Conference might aid in pressing upon the Government these much needed reforms.

On "Isolation Hospitals," by J. Groves, M.D.

Any person who is able to look back a quarter of a century to a time when he was intelligently observant, can scarcely fail to note, when he compares the present with the past, that a great change in public opinion has taken place, and is still going on, with reference to the views held as to what may be described as the relation of the individual to the community, and more particularly as regards matters appertaining to the interests of the public health. Sometime since, I was walking down Parliament Street, and observing a structure in the middle of the roadway not far from the offices of the Local Government Board, curiosity prompted me to ascertain its object. Descending a flight of steps from the road-level I found myself in a spacious apartment lined with white glazed tiles, and having a tessellated pavement, on one side of which was a row of water closets, on the other side a row of white enamelled earthenware urinals, and at the end a lavatory with marble fittings. There was absolutely no smell, and the apartment was such a one as

would be found only in hotels of the very highest class. A notice set forth that this arrangement for the convenience and comfort of the public had been provided by the Vestry of St. Martin's parish. I fairly rubbed my eyes. On ascending to the road I found there was another flight of steps leading, presumably, to a similar apartment for the accommodation of ladies. Subsequently I discovered that such places had been constructed by the vestries of other parishes, and as the land beneath the roadway has been vested by Parliament in the vestries for this purpose, and as no ground landlord's agent can now bar such a public benefit, the provision of like conveniences to the whole of the metropolis will only be a question of time. These arrangements made by the community for the benefit of the community as a whole, although many of the individual contributary ratepayers may never participate in the advantages they afford, will serve to illustrate the change in opinion I have indicated.

A quarter of a century ago, when, endowed with almost autocratic powers by the Privy Council, I had the honour to hold a sanitary appointment during the cholera epidemic of 1866 in one of the large districts of the Metropolitan Board of Works, which included, if I remember rightly, a part of this very Parish of St. Martin's, a Metropolitan Vestry would scarcely have conceived it possible that twenty-five years later it would be considered seemly and right that the money of the ratepayers should be used in making the best possible arrangements for the comfort of the community, that the individual interest would cease to be prominent and would become merged in the general interest of the community. Not that there was any supineness in the presence of cholera. Much was done: wells were closed, there was a general clearing up of insanitary conditions, and there was no stint of expenditure whatever; the poor among the cholera patients were treated at the public expense. Great commiseration was felt for the unfortunate sufferers, and disinfectants flowed in streams along the streets and down the sewers. But whatever the views of the Privy Council may have been, public attention was concentrated upon the victims of the disease, and public feeling was benevolent to a degree with reference to them. But public opinion was not prepared to sanction the removal and the lodging elsewhere at the public expense of the inhabitants of crowded houses which had become infected, because there was a poison abroad, threatening the public safety, which had been caught or imprisoned; or the provision out of public funds of trained nurses for the sick, in order that they might be more perfectly isolated, and not that they might be better nursed. There were

no hospitals of the Metropolitan Asylum's Board in those days, and had it not been possible to send many of the cholera patients to hospitals supported by voluntary contributions, the result of the invasion would have been disastrous. The great hospitals saved London in 1866, when cholera poison was regularly turned on by the turncocks to houses supplied by the East London Waterwork's Company.

The almost universal acceptance of the popular Notification of Infectious Diseases' Act, notwithstanding its interference with the liberty of the individual and with the privacy of his home, and notwithstanding that the notification fee is paid out of the public purse, is alone sufficient evidence of the adoption by a large body of intelligent opinion of the principle that in matters appertaining to the public health, at least, the well-being of the community at large dominates every other consideration. And if this principle applies to notification, it must necessarily apply to the corollary of notification—the isolation hospital. The principle underlying the isolation hospital is that of the maintenance of the general well-being at the expense of the individual, that is to say, of those who in the aggregate make up the community, which is, indeed, the principle, and the only principle, upon which sanitary legislation should be founded, and which is the principle, and the only principle, upon which sanitary law should be administered. If this be universally recognized as the guiding principle in sanitary matters, there should be no difficulty in deciding the course either of legislation or of administration. If it were so universally acknowledged the legislature would not permit matters so vital as notification and isolation to be permissive, and sanitary authorities would not endeavour to throw the whole of the burden of sanitary improvements upon those obviously and directly benefited only.

The public health cannot be secured in any community if the poison of infectious disease is disseminated through it. Notification points out the spot at which the poison is being generated, disinfection destroys it after it has been produced, isolation alone will render its production harmless. The person producing the poison may be isolated on the spot, either by removal of the other inmates of the dwelling or by appropriating one or more rooms, with certain precautions, to his exclusive use; but, as a rule, efficient isolation can be obtained with certainty only by taking him out from among the community, and if this be so, a place must be provided to which to take him, and the provision of that place must necessarily be made by each individual ratepayer contributing his share of the cost of it. Equally certain is it that the removal of the person who is poisonous and his

maintenance while he continues so, must be provided for in the same manner. From a humanitarian point of view it is satisfactory that he will benefit; but the provision of an isolation hospital and his removal to it is not done for his benefit, but for the protection of the community of which he forms part. In an economic sense the expenditure necessary to the establishing and maintenance of an isolation hospital is, doubtless, a wise investment having regard to the money cost of sickness; but this is quite a secondary consideration, altogether subordinate to the main object of its existence, which is that it affords an additional and powerful safeguard to the community against disease and death.

Of the 1,510 provincial sanitary authorities in England and Wales, rather more than one fourth have made provision for isolating cases of infectious disease. Dr. Thorne Thorne is my authority for this statement. It would appear, therefore, that in nearly three fourths of the provincial sanitary districts the principle to which I have referred is not observed as regards the isolation of the poison of infectious disease. Among these are districts which actually include watering places and health resorts, which are especially liable to the introduction of zymotic disease because convalescents are removed to them while still poisonous. The authorities who administer the sanitary law in such places would appear to be particularly culpable, for they not only leave the normal population without such protection as isolation may afford, but their visitors—who are to them what a manufacturing industry is to another community, their source of wealth, and many of whom are, possibly, invalids—are also left without this form of protection. In places so visited all must agree that sec. 131, P.H.A., 1875, should read, "authority *shall* provide" instead of "authority *may* provide."

The principles which govern the construction of an isolation hospital are embodied in the memorandum as to Isolation Hospitals issued by the Medical Officer of the Local Government Board, and it is unnecessary to consider the details now. Some who are present had the opportunity of inspecting, a few weeks back, a large hospital so constructed, at Nottingham, and very perfect it seemed to be, and worthy such an important community as it is intended to protect. A similar hospital exists here, and it is, doubtless, of enormous assistance to my friend Dr. Mumby, who so efficiently safeguards the interests of the public health of the great community we are visiting. In passing, I may say that the Mayor of Portsmouth has told me this hospital is of the greatest service and most popular, and the worthy Alderman, who is the Chairman of the Health Committee of the Corporation of Nottingham, remarked that notwith-

standing the large outlay which the provision of the hospital involved, the ratepayers of Nottingham would only be too thankful if there was no necessity to make use of it.

Although in several districts in which Notification is in force the old estimate of one bed per 1,000 of the inhabitants has been found too low, it is probable that when it becomes universal this estimate will be too high; but much will always depend upon the character of the population, and upon other circumstances. It is impossible to say now what the mean proportion will in the end prove to be, so vitiated at present are the notification returns by the presence of non-protected districts. A district in which scarlet fever is permitted to burn itself out, occupying two years, perhaps, in the process, must materially affect the notification returns in surrounding districts. Less difficult is it to determine the amount of space each bed will occupy, and to ascertain, therefore, the size of ward or pavilion. It is pretty generally agreed that in a well-ventilated ward the smallest allowance of air-space per bed should be 2,000 cubic feet. Dr. Thorne Thorne has proposed that each bed should be allotted a floor space of 12 ft. × 13 ft., the bed standing 1 ft. from the wall, which does not seem too generous an allowance.

The infectious diseases which with us call for isolation in hospital are in the order of their importance: scarlatina, typhus, small-pox, diphtheria, enteric fever, and cholera. Those less frequently isolated in hospital are erysipelas, measles, whooping cough, and puerperal fever.

When they possess an isolation hospital it is for the welfare of the community that each case of infectious disease which occurs in their midst should be isolated there. Every inducement to use the hospital, therefore, should be offered. The best nursing, the best attendance, the best cooking should be provided. What are known as the better classes should be especially encouraged to send their sick there if only to remove the suspicion of pauperism which the mechanic and labouring classes may have. The medical man who has been treating the case should continue to attend it; mothers or near relatives should be allowed to enter the hospital with a child and remain there if they wish; and the freest access compatible with the public safety should be permitted at all times, more particularly in serious cases, every precaution in the way of disinfection being taken before a visitor leaves. No payment should be accepted even if it be offered by the rich, for in doing so the principle for which I contend would be destroyed, and the stigma of pauperism would attach to those who did not pay. The 132nd sec. P.H.A., 1875, which recognises the system of

payment, and something more, should be repealed. It would be better, in my opinion, to offer premiums to those who are willing to secure the public safety by entering the hospital, than to put this clause into operation.

We, as Medical Officers of Health, have it in our power to mould public opinion in our several localities upon this as well as upon other questions; and having determined in our own minds the principles which should guide us, the more fearless we are in giving expression to our opinions the more quickly—for public opinion is paramount—will be attained the great object we all have in view, the security of the public health throughout the land.

On the "Condemnation of the Meat of Tuberculous Animals," by ARTHUR NEWSHOLME, M.D., Medical Officer of Health for Brighton.

ABSTRACT.

1. It is generally admitted that tuberculosis is an infective disease, capable of being produced by specifically infected ingesta.

2. Everyone will also admit that the flesh of tuberculous animals, to which diseased pleura or glands are still connected, is a source of real danger. Cooking cannot be allowed to enter into consideration, as much meat is eaten underdone or raw.

3. It is universally agreed that the flesh of tuberculous animals in which general wasting has occurred, whether the disease be local or general, should be condemned.

There remain, therefore, in dispute only the cases in which more or less tuberculosis exists, without at the time of slaughtering having impaired the apparent nutrition of the animal. In these cases the internal organs may be studded with caseous masses, or all the serous membrane may be extensively implicated.

Are emaciation and bad condition of the tissues to be the sole test in condemning the flesh of tuberculous animals?

If tuberculosis is an infective disease, spreading by the lymphatic or vascular circulations, its infectivity is probably greater in the early stage of a tuberculous growth than at a later period, when the bacillus has been killed by the caseating products of tubercle.

It cannot be expected that we should have much evidence of tuberculous disease traceable to infected food, the conditions of life being so complex. There is, however, experimental evidence of this in lower animals.

The following resolution is submitted :—

That where tuberculosis of a single organ of the body impairs the nutrition of the flesh, the whole animal should be condemned; and that where tuberculosis affects more than one organ, or where more than one serous surface is extensively implicated, the whole animal should likewise be condemned.

"*The Purification of River Water by Agitation and Metallic Iron, as conducted with the water of the River Severn at Worcester*," *by* HORACE SWETE, M.D.

ABSTRACT.

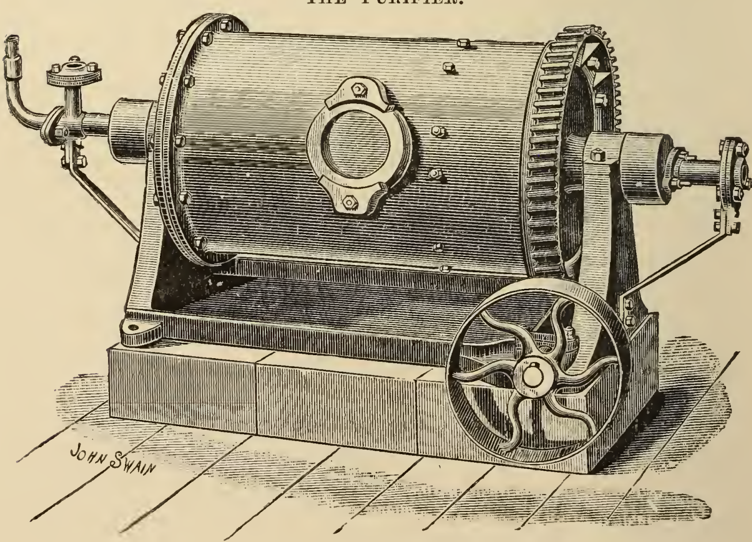
THERE are few subjects of greater importance and interest to us, as Medical Officers of Health, than that of obtaining a wholesome and sufficient supply of water.

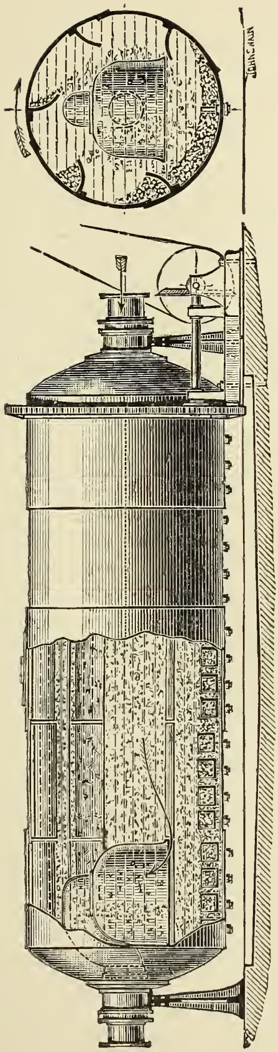
It is a sanitary axiom, that a water that has never been polluted is far better than a polluted water rendered pure by filtration or other means, however successful the purification may be; but there are many districts in this country where pure deep well water cannot be obtained, and if it can there is not a sufficient supply. Our large towns, as Liverpool, Manchester, Birmingham, and others, are giving up their deep wells and are seeking an inexhaustible supply from Lakes, or the upper waters of rivers, above the pollution of towns. This is, however, too costly a process for our smaller towns and villages, whilst frequently a river or brook, if only it could be sufficiently purified, would afford an ample supply for the population. In the City of Worcester we are in that position with the ordinary surface wells grossly polluted; a deep well supply of very doubtful quantity; and a river with an inexhaustible supply, but of polluted water. For many years the river has been the source of our town supply, filtered through sand filters, but these have been unable to cope with the impurities, especially the peat and kaolin, which the Severn contains in large quantities. Recently the City has undertaken an experiment on a large scale to purify the water by means of Anderson's Revolving Purifiers. These have been at work since June 7th, 1892, and as I have made daily analyses of the river and of the purified water, I am able to place facts before you that you may consider whether such a method may not be equally applicable to other places.

There is nothing new in the principle; it is the old plan of shaking up the water with some pieces of iron in it, allowing it to settle, and filtering off the thick matter, when the water is rendered bright and clear. Years ago it was a common custom

in the West of England to put a few rusty nails in a bottle of bad water and shake them up, by which the water was greatly improved. The wooden barrels for water on board ship are now exchanged for iron tanks, the motion of the ship enabling the iron tank to keep the water sweet for a lengthened voyage. For many years there have been processes in use for purifying water with iron, more or less successful. The most important filter for domestic filtration is that in which Bischoff's "Spongy Iron" is made use of as a filtering medium, which can be from time to time renewed, and this has held a deservedly high place amongst filters for home use. On the large scale, however, it has not been so successful. At Antwerp, where the water supply is derived from the tidal river Nethe, a river largely polluted with organic matter and peat, spongy iron was at a great expense used as the filtering medium, 900 tons being mixed with three times its bulk of fine gravel in the filters; for two years this gave excellent results and then gradually the filters became choked, and the spongy iron converted into a hard and concrete mass; in 1884 the system was abandoned, the cakes of spongy iron being broken up with a pick with considerably difficulty, and Sir Frederick Abel suggested to Dr. Anderson, that if the spongy iron could be kept in motion in the water to be filtered it might be more successful; Dr. Anderson therefore designed the Revolving Purifier, and found that pieces of iron and preferably the burrs made in punching iron plates, were even more effective than the spongy iron previously used.

THE PURIFIER.





These illustrations shew the plan of the Purifiers, the smaller size being that designed for Village supply. The larger cut shews the interior arrangement of shelves for the cascade of Iron and the dependant Funnel through which the water is discharged from the Purifiers.

This apparatus is extremely simple. A large iron cylinder, capable of revolving on hollow trunnions, through which the water passes in and out is constructed; this cylinder is fitted with four or five rows of shelves in echelon, so that as the cylinder revolves, the iron burrs are taken up by the shelves and discharged through the water, the cylinder giving thirty cascades of iron in each revolution. To retard the water from

passing straight through too quickly, the outlet trunnion is fitted with an inverted funnel, the open mouth always facing the bottom of the cylinder, and a few inches from it. These cylinders are made of various dimensions according to the amount of water to be purified, but for large works one or more of about twenty feet long by five feet in diameter, with twelve inch openings are mostly used, and are capable, if working for twenty-four hours, of purifying about one million gallons of water. The rate of contact is generally three-and-a-half minutes, the time however is regulated by the character of the water to be purified, and if the nature of the impurities require it air is at the same time pumped through the cylinder. To enable the water in the purifiers to be maintained at various heights during their revolution, which may be required to be altered according to the nature of the water to be purified, the tank into which the purifiers discharge their contents is fitted with sluice boards so that the level of the water in the tank and consequently the depth of water in the purifiers can be altered by removing one or more sluice boards.

After passing through the cylinder, the water flows along a trough of some length, falling in a cascade into a settling tank; during this passage it is aerated by air being pumped through the water as it flows along the trough; the water is then allowed to remain in the settling tank about six hours, when it is drawn off by a suction pipe, floating three inches underneath the surface, into an ordinary sand filter bed, from the bottom of which it is delivered at the rate of four to six inches an hour into a pure water tank, and from thence it is distributed over the town.

Such is a brief description of the most general form of working this apparatus. I have purposely refrained from giving any engineering data, as the object of interest to us as Medical Officers of Health is the method by which the water is purified and the amount of purification.

The Rationale of the Process.

The numerous analyses I have made of the water in the different stages of the process, as well as the sand and deposits in the filter beds, enables me to offer for your consideration a theory of the nature of the work done in the purifiers and filter beds, which appears to me to be, in the main, borne out by analytical facts.

The process consists of three parts :

(a) The work effected in the purifiers.
(b) The result of aeration and subsidence.
(c) The work done by the filter beds.

(a) The work done by the purifiers.

The water of the river going into the purifier contains about 9·4 millegrammes of dissolved oxygen per litre, on passing out this is reduced to about six millegrames, the water has therefore lost oxygen, which has oxidised some of the iron to form ferrous oxide, and this is dissolved in the water to the amount of 0·3 grains to the gallon.

The free or saline ammonia is unaltered.

The organic matter, which would be estimated as albumenoid ammonia, is unaltered.

The organic matter principally carbonaceous, which is estimated by the amount of oxygen required to oxidise it, is diminished to the amount of about 40 per cent., it is possible that some of this may have been converted into carbonic acid, as Professor Crace Calvert has shewn, that iron does not oxidise in water, except in the presence of carbonic acid.

The number of colonies of microbes is not diminished.

The work of the purifier is therefore to reduce the amount of dissolved oxygen, to reduce the amount of carbonaceous matter, and to form ferrous oxide.

(b) The result of aeration and subsidence.

The water, which is now of a greenish brown colour, from the ferrous oxide, passes along the trough, where air is blown into it through the false floor of the trough ; this changes the green ferrous oxide into the red ferric oxide, or ordinary iron rust. As the water passes along the trough and falls into a cascade, into the settling tank, it is further aerated, so that when it reaches the filter bed it contains more dissolved oxygen than was originally present in the water of the river.

During the oxidation of the ferrous oxide, a gelatinous cloud is formed, which entangles into itself saline ammonia, organic matter, and some of the microbes.

The aeration and settling tanks therefore oxidise ferrous oxide into ferric, add oxygen to the water, and entangle saline ammonia, organic matter, and microbes in the gelatinous coagulum formed by the oxide of iron.

To show that this is the case I collected some of the deposit precipitated after aeration, and found it to contain besides the ferric oxide, of free ammonia 5·3 parts per 100,000, and of albumoid ammonia thirty parts per 100,000 the nitrites being nil and nitrates a trace.

It is evident that it is here, as well as in the sand of the filters, that the saline ammonia and the organic matter is arrested, not being chemically decomposed, but mechanically caught in the coagulum of the oxide of iron.

(c) The work done by filter beds.

In Worcester the settling tanks and filters are insufficient to allow the water to be retained in the settling tanks for more than three hours, so that much of the precipitate, which ought to have been retained in the settling tank, passes over to the filters, giving them extra work to do. Had the settling tanks and filter beds been specially designed for the system, the water passing to the filter beds would have been almost clear, so that some of the free and albumenoid ammonia found here must really belong to the settling tank.

An analysis of the sand of the filters gives 2·6 of free ammonia and 2·7 of albumenoid in 100,000 parts.

Oxygen is also taken up in passing through the filters, the filtered water having rather less oxygen than the river water, a freshly-made filter taking up nearly 50 per cent., which is gradually lessened as the filter gets in working order to 6 per cent. At Antwerp, where the filters have been working for six years, this action has ceased, and the filtered water contains more dissolved oxygen than the river water, as shown by Dr. Tidy's analysis.

As the water passes through the filters generally at the rate of six inches per hour, the surface sand collects the film of precipitated oxide of iron and organic matter, and the sand grains become gradually coated with ferric oxide; this will not wash off when the surface sand is cleansed. The coating of oxide gradually extends throughout the filters, absorbing oxygen from the water to complete the oxidation of the iron; by this means the interstices of the filter get gradually smaller and enables organic matter and microbes to be more completely trained out. From time to time half an inch of the surface sand is taken off and washed; this, when the filter is too thin, is replaced again. Now the most perfect filter is the "Chamberland," which is merely a piece of baked porcelain, unglazed, through the minute pores of which organic matter and microbes will not pass, so that it completely mechanically sterilizes the water, so much so that this filter is used by bacteriologists for the collection of microbes for microscopic examination. Now what the process does is to convert the sand filter into as near a resemblance to a "Chamberland" filter as possible. The "Berkefeld" filter, made of fossil earth, "Kieselguhr," also acts in a similar manner. This view is carried out by my cultivations of microbes in the water of each individual filter. During the experimental stage, No. 5 filter was remade from the bottom with three feet of fresh sand. A cultivation made a few days after it was put into action gave over 500 colonies per cubic centimetre, the river giving about 9,000; this has

been gradually reduced to a little over the 100; filters No. 2, 3, and 4 give 91, 50, and 95 colonies, whilst No. 1 filter, which is very thin and requires remaking up to the usual depth of sand, is gradually giving more and more colonies. A more recent cultivation of the water of the separate filters gives—

No. 1	... ...	100 colonies.
" 2	... ...	90 "
" 3	... ...	40 "
" 4	... ...	None.
" 5	... ...	40 "

being a mean quantity of 54 in a cubic centimetre.

Prof. Roux gives the following table:—

Water excessively pure	5 to 10	colonies per centimetre cube.
Water very pure ...	10 to 100	" "
Water pure ...	100 to 1,000	" "

It is clear, therefore, that the sterilization of the water is mechanical, and is more or less nearly perfect, as the pores of the filter are contracted by the aggregation of the oxide on the particles of sand. This shows the importance of not disturbing the crust of the filter, and that this process cannot be allowed after it has once started, as is too often the case, to go on, in a happy-go-lucky manner, but must have continuous and intelligent supervision.

To sum up the rationale of the process, it is *chemical* so far as the formation of the oxides of iron are concerned and the reduction of some of the carbonaceous organic matter; it is after that *mechanical*, reducing the pores of the filter and enabling them to undertake what they could not perform before, especially with peaty and clayey waters.

I think that when a supply of deep well water cannot be obtained, the result of the experiment at Worcester shows that there is a process that may render a river or brook water sufficiently good to come within the category of potable waters, and must therefore be a subject of interest and importance to Medical Officers of Health.

On "The Interpretation of Results in Water Analysis," by
JOHN C. THRESH, D.Sc., M.B.

ABSTRACT.

In face of the probable introduction of Cholera, a disease spread largely by specifically polluted water, this subject is of special importance at the present time. All Medical Officers of Health who have studied this subject will I think agree that it is much more easy to make an analysis of a sample of water than to interpret correctly the results. Unfortunately, the popular opinion is that any man who can make such an analysis is competent to speak with authority as to its quality and suitability for domestic purposes and to give an opinion as to whether it has produced, or is likely to produce, disease. Still more unfortunately this is the view taken by nearly every Chemist, whatever his qualifications or lack of qualifications, and the readiness of most analysts to give such an opinion upon any sample of water, whether anything of its source and history be known or not, is probably the cause of the public holding so tenaciously to this error. It is too much to expect that a person desiring to know the quality of his water supply will first submit it to a Chemist for analysis and then submit the analysis to a medical expert for an opinion. The opinion should be given by the person who makes the analysis, and, to make the opinion of any weight, it should be given by a person who has had a medical training and who has made the subject a special study, therefore the Analyst should be a Medical Officer of Health, or, at least, possess the qualifications necessary for becoming one. I regret that a contrary opinion is held by those in high places, and that a very slight acquaintance indeed with practical water analysis is necessary for obtaining a diploma in Public Health. The result is, that on the one hand we have Chemists giving opinions which ought only to be given by Medical men, and on the other hand we have Medical men (M.O.H.) giving opinions based often on most inadequate and unreliable data. No wonder, therefore, that diametrically opposed opinions are sometimes given with reference to samples of water from the same source.

The writer holds that the Analyst, even supposing him to be a M.O.H., is rarely justified in expressing an opinion as to the fitness or unfitness of a water for domestic purposes unless he knows something of the history and source of the sample.

The more important points to be ascertained were indicated, and attention was drawn to the fact that in many wells, especially shallow wells, the water often varies considerably from time to time and at different depths, being especially liable to change after heavy rains.

The relative importance of the various constituents in waters from different geological formations was discussed, and the various methods of measuring the amount of organic impurity briefly alluded to. It was shown that none of these gave any reliable indication of the nature of the organic constituents, and even when supplemented by both a Microscopical and Bacteriological examination there was often room for doubt. To condemn one water which yields a little more alb. ammonia than another or because it contains a few more organisms than another when we know nothing of the nature of the substance yielding the ammonia and nothing of the character of the organisms is obviously so illogical as to be absurd, and yet this is what is almost invariably done. In very many cases the results even of the most careful and complete analysis must be supplemented by a Microscopical and Bacteriological examination and by a thorough investigation of the source of the water and of the possibility of its being contaminated before an opinion can be given, and even then there is the possibility of the opinion being erroneous.

NOTE.—The Resolutions passed at this Conference are referred to on page 345.

CONFERENCE OF MUNICIPAL AND COUNTY ENGINEERS.

ADDRESS

BY

H. PERCY BOULNOIS, M.Inst.C.E., City Engineer, Liverpool.

PRESIDENT OF THE CONFERENCE.

It is scarcely necessary for me to tell you the great pleasure it gives me to be present to-day in the position I have the honour to hold as President of this Conference of Municipal and County Engineers. The pleasure, as you may suppose, is greatly enhanced by the fact, that so many years of my private and professional life were spent in this important and prosperous Borough, and that my recollections of those years are full of pleasant memories of my work and of the friends and acquaintances that I made. It is also a very great honour to me that I should have been invited to occupy this position as your President, as there are so many men who are more capable of fulfilling the duties, but no doubt my former connection here as Borough Engineer guided those who are responsible for the selection, and it will be my endeavour, with your kind assistance, to make this Conference a success. It is the first time in the history of The Sanitary Institute that such a Conference has been held, and I trust that this new departure in the programme may be fraught with good results to The Sanitary Institute as well as to those of us who are taking part in this Conference, and that the success of the experiment may justify a repetition in coming years.

The growth in the importance of Municipal and County government within recent times is one of the remarkable episodes in the present remarkable era. During the reign of Her Most Gracious Majesty Queen Victoria, each successive Parliament seems to have vied with its predecessor in passing

Acts to confer extended and broader powers on the local governing bodies of this country, with a view to meet the sanitary and other requirements of the nation. This increase in the powers and responsibilities of local governing authorities has undoubtedly necessitated the educational advancement of the executive officers of those authorities, and I venture to believe that amongst those officers the advancement of the Municipal and of the County Engineer in professional knowledge and skill has fully kept pace with the times. His evolution has been rapid, and the "fustian jacketted plodding man of highways and bye-ways," as described by Sir Henry Acland, has developed into the skilled and scientific Municipal or County Engineers of to-day, some of whom hold a world-wide as well as a local reputation. Nor can this be surprising when we consider the cosmopolitan nature of their duties, which I have attempted to describe on a graphic diagram (facing page 320). It will be noticed that I have divided the duties of such officers into six chief branches, viz., *Engineering*, *Architecture*, *Surveying*, *Law*, *Administration*, and *Miscellaneous*. These I have sub-divided under their different heads, which have again been further sub-divided into their different ramifications, and which can only be explained with the assistance of the diagram, for it would be almost impossible to do so in writing, as you will at once understand if you count the number of subjects I have enumerated, which amount to 98.

I gave a short descriptive paper and exhibited this diagram last year at the International Congress of Hygiene and Demography, and in the discussion which followed no one could gainsay that I had faithfully represented the duties and work of Municipal Engineers, and thus it may fairly be conceded that the diagram is a faithful record of some, if not all, of the work we may at any time be called upon to perform.

Having, then, referred to the diagram, it becomes a question as to what has been the result of this growth of local powers and responsibilities, and of the evolution of the officers of Local Authorities. The majority of the villages, towns, and cities of this country are now well and efficiently drained and sewered. They are supplied with an abundance of wholesome pure water; their streets and roads are well paved and lighted; their houses are built under supervision, which prevents grave abuses during construction; the house refuse is systematically removed to unobjectionable localities, or burnt; and the streets and roads are cleansed and sprinkled. Parks and recreation grounds afford free and wholesome amusement to the citizens, whilst public baths and washhouses give them opportunities of cleanliness and health; and in many localities—

notably in this town where we are now assembled—trees planted at the verge of the roadways, give shelter from the sun and a charming appearance to the vicinity. The recent visit of that terrible scourge, the Cholera, to our shores has shown us the value of such works, and of the vigilance, skill, and unwearying zeal of our brother officials, the Medical Officer of Health and the Sanitary Inspector. Although the cholera has been brought amongst us it could not take root; good water, efficient sewerage, proper scavenging, plenty of air and light have been too much for it. Such a disease can never be epidemic in this country, thanks to sanitary works and sanitary precautions.

Let me for a moment compare our present surroundings with those of only sixty years ago to give some idea of the advance in sanitation that has been made. Sewers for the conveyance of fœcal matter were almost unknown: sewage disposal was an unknown term; the streets and roads were shockingly ill-paved, if paved at all; the water supply was insufficient and often impure, and the condition of the dwelling houses can scarcely be conceived. What do we find as to the condition of London in 1840. One of the early pioneers of sanitation, the late Mr. Roe, the Surveyor to the City Commissioners of Sewers, says in a report of that date:—

"The whole evaporating surface of stagnant and pestilential matter beneath the houses and streets of the metropolis has been estimated to be equal to a canal 10 miles long, 50 feet wide, and 6 feet deep, and if spread out 6 inches in thickness would form a pestilential swamp 800 acres in extent, being nearly three times as large a surface as the whole population of London could lie down upon." He does not attempt to estimate how many "colonies" of bacteria it would accommodate. In a more detailed report, amongst other equally impressive cases, he states with reference to a certain dwelling house in London that "the basement is flooded to a height of 3 feet, with excrement, ashes, and dead animals and other offal saturated with filthy water." It is not surprising to hear in the same report that out of 877 patients then in the London Fever Hospital, 211 cases came from this locality! One can scarcely believe that such a condition of things could have existed so recently, and that in a short sixty years such a remarkable change could have been effected.

The scientific construction of drains and sewers is now an accomplished fact, improvements in house drainage and fittings are making almost daily strides, the supply of potable water from shallow impure wells is almost a thing of the past, as is also its storage in improper receptacles. The economical, and

GINEERING.

Bridges.

TRAMWAYS.

Prevention of Floods.

Street Lighting.

Water Carri

ot-walks.

Electricity.

Gas.

Partially Separate System.

Separate System.

le. Electric. Steam. Horse. Compressed Air.

. BRICKS.

SURVEYING.

Electric Lighting Acts and Orders

Quantity Surveying.

FIELD WORK.

LEVELLING.

VALUATIONS.

ADMINISTRATION.

Removal of Snow.

Staff.

Contracts.

Committee.

Collec

Wages.

Statistics.

Reports.

Correspondence.

Records.

Corporation Buildings.

Dang Struc

Artisans' Dwellings.

Public Baths.

Mortuaries.

Markets.

Abattoirs.

Safe Thea

THE SIX CHIEF BRANCHES OF MUNICIPAL ENGINEERING.

ENGINEERING.

- Bridges.
- Sewerage.
  - Water Carriage
    - Partially Separate System.
    - Separate System.
    - Complete System.
  - Dry System.
    - Earth Closets.
    - Tubs.
    - Pails.
    - Middens.
  - Disposal.
    - Irrigation.
      - Filtration.
        - Precipitation.
- Water.
  - Collection.
    - Rivers.
      - Springs.
        - Gathering Grounds.
          - Deep Wells.
  - Supply.
    - Constant.
      - Pumping.
    - Intermittent.
      - Gravitation.
- Road Making.
  - Traffic.
  - Macadam.
    - Road Rolling.
  - Paving.
    - Stone Setts.
    - Wood.
    - Asphalte.
    - Bricks.
  - Foot-walks.
- Tramways.
  - Cable.
  - Electric.
  - Steam.
  - Horse.
  - Compressed Air.
- Prevention of Floods.
- Street Lighting.
  - Electricity.
  - Gas.

LAW.

- Electric Lighting Acts and Orders.
- Sanitary Acts.
  - Special Acts.
  - Bye-Laws.
- Gas and Water Acts.
- Parliamentary Work.
  - Oppositions and Promotions.
  - Extension of Boundaries.
  - L. G. B. Inquiries.
- Arbitrations.
- Contracts.

SURVEYING.

- Quantity Surveying.
- Field Work.
  - Levelling.
- Valuations.

MISCELLANEOUS.

- Removal of Snow.
- Scavenging.
  - Collection.
  - Disposal.
- Road Watering.
- Hygiene.
- Landscape Gardening.
  - Recreation Grounds.
  - Cemeteries.
  - Parks.
- Disinfection.

ADMINISTRATION.

- Staff.
  - Tradesmen's Accounts.
  - Wages.
- Contracts.
- Committee.
  - Statistics.
  - Reports.
    - Correspondence.
  - Records.

ARCHITECTURE.

- Building Surveyor.
  - Dangerous Structures.
    - Safety of Theatres.
  - Inspection of Plans.
    - Streets in Progress.
      - Defects in Dwelling Houses.
      - House Drainage.
    - Buildings in Progress.
      - Factories.
- Corporation Buildings.
  - Municipal Offices.
    - Police Stations.
      - Fire Stations.
  - Artisans' Dwellings.
    - Public Baths.
      - Mortuaries.
  - Markets.
    - Abattoirs.

at the same time efficient paving or metalling of our roadways is receiving close attention, the sewage as it emerges from the sewers need no longer pollute our rivers or streams, but can be dealt with in an endless variety of ways ; the lighting of our streets by electricity or improved gas burners points almost to the prolongation of the light of day, and advances have been and are being made in every branch of the profession to which we belong.

Much has been done in the past, but much remains to be accomplished in the future. Our sewers, scientifically as they are constructed, still require improvement, if not in their shape, in the materials with which they are constructed, and the question of their proper ventilation is still a long way off a settlement. The debateable question of the best method of sewage disposal still exercises our minds, and the "waste-not" faction still clamour that no system which breaks the "food circle" can be correct. Greater simplicity is still required in the sanitary arrangements of the dwelling, and the proper and economical housing of the working classes is still an unsolved problem. We have not yet found a pavement which complies with all our requirements, as if durable it is slippery, or if not slippery it is noisy. Our street lighting is by no means satisfactory, and the controversy between gas and electricity is by no means settled. These and many other points show us that there are many fields still open for discovery and improvement. Nature hides her secrets very jealously from our search, and they are only dragged forth by patient investigation, experiment, and toil.

> Take the spade of Perseverance,
>   Dig the field of Progress wide ;
> Every blinding root of error
>   Harrow up and cast aside.

What I have desired to convey to you in this very imperfect address is that the knowledge which a Municipal or County Engineer should possess is almost without limit, as it is not possible to say on what question he may at any time be called upon to advise the local authority. It is therefore, I venture to think, of the greatest importance that this officer should have ample opportunities of enlarging the scope of his knowledge and experience by intercourse with his professional brethren, and by visiting other towns and localities, and by the inspection of engineering works. It is just such Conferences as this which we are now holding that tend greatly to enlarge our knowledge and our ideas, for it enables us to come together and exchange our different views of professional subjects, to try and learn what others know, to avoid mistakes that others have made, to

submit our theories to others, to listen to their remarks upon them, and generally to bestir ourselves to keep pace with all the scientific advancement which is going on around us. I do not think that local authorities quite realise the immense benefit it would be to their officers and to the communities they serve if they were officially sent to take part in such conferences as this we are now holding, or to the meetings of the Incorporated Association of Municipal and County Engineers, which are held throughout the year at different localities in the United Kingdom. I wish local authorities would realise that such meetings tend to raise the views and enlarge the ideas of their officers, and that the knowledge acquired at such conferences can but benefit the ratepayers. Our American cousins are quite alive to this fact, and consequently meetings and conferences are always largely attended in that country; in addition to which officers out there, who hold similar positions to ours in this country, are frequently sent to Europe for several months at a time to gain information as to what is being done over here. The result has been that America is rapidly gaining upon us in Sanitary Engineering knowledge, and if we are not careful may pass us in the race where at present we are in the van. Nothing is easier than to get into a self-satisfied groove, but self-satisfaction means stagnation, and a groove gets deeper and deeper. I will not detain you longer. We have met together for the discussion of various papers of considerable interest to us all, and which cannot fail to advance our professional knowledge. It is, as I have said, an intense pleasure for me to be here, and I thank you for the hearing you have given to my address.

On "Town Refuse and Refuse Destructors," by C. JONES, M.Inst.C.E.

ABSTRACT.

Town refuse. Material to be dealt with.

Original modes of treatment not now tolerated.

Late unsatisfactory legal decision as to the responsibility of Contractors or Local Authorities.

Best mode of dealing with the difficulty, viz., "Fire."

Handling the material, objectionable and unremunerative.

Refuse can be consumed, or nearly all.

Original furnaces, failures owing to faulty construction.

Fryer Destructor, 1892.
Warner "Perfectus" Destructor.
Whiley's "New Destructor."
Boulnois improvements for feeding, &c.
Conveyance of material and description of method of feeding the apparatus.
Arrangement to prevent nuisance from dust being blown about, and for preventing the temperature in flues being lowered.
Residuum and its value.
Steam producing power. Opposition to erection of destructor.
Site for same.
Destructor, may be built anywhere without nuisance being caused.
Dr. Stevenson's opinion as to Destructor with Cremator.
Invention of Fume Cremator, and description of same.
At Ealing sewage sludge mixed with ashes and mixture destroyed without nuisance.
Report of F. M. Rimmington, Esq., to the Corporation of Bradford.
Towns where steam power is being utilized, and purposes for which it is used.
Value of Destructor on Sanitary grounds. General conclusion.

On "Street Gullies and Road Cleansing," by W. B. G. Bennett, Assoc.M.Inst.C.E., Borough Engineer, Southampton.

Having frequently found in the course of my experience a considerable difficulty in cleansing efficaciously the modern street gully and the removal of road slurry, I have endeavoured after much attention and experiment to devise some improvement to replace the present road gully now in universal use, and to facilitate the taking up and removal of the road slurry arising from the sweeping of the carriageways.

The ordinary street gully being well known it is unnecessary for me to enter into a lengthened description of the same, more than to say, the primary object of a road gully is briefly to pass the rainfall to the sewer, and intercept the road detritus and other matters often of an objectionable nature, and prevent their entrance into the sewer. For this purpose it is generally made with a catch-pit of various dimensions placed at certain depths below the point of overflow under the surface of the road. It is

usually covered at the level of the street channel with a movable iron grating, varying in dimensions but generally about 20 inches by 15 inches, which, in nearly all cases, is the only means of access to the same; through this small opening the whole of the deposited matter has to be dipped out from the bottom of the catch-pit by what is known as a gully tool, an implement very similar to a ladle attached to the end of a light rod several feet long, and I find, however expert the labourer may be in manipulating this implement, the operation is one occupying considerable time, and as every ladle-full has to be thrown into a slurry cart the operation is very often attended with inconvenience to the public, besides which this method of cleansing owing to the construction of the modern gully is only palliative, and a large quantity of offensive accumulation is always left behind.

To minimise the insanitary effect of this, a deodorising material is usually thrown into the pit and on the surface of the road and grating, as may be frequently seen by the casual observer.

My experience has led me to the conclusion that to efficaciously cleanse a road gully, it must be constructed so as to permit the deposited matter being speedily, entirely and constantly removed, and discharged without inconvenience directly into a cart or other appointed conveyance, and upon sanitary grounds I will even go so far as to say that all gullies should be cleansed once every day, especially in hot weather; with a desire to secure this desideratum, I have devised several appliances. I term them first, the "Hydraulic Self-cleansing Street Gully," briefly described, it is intended for use in places where water can be obtained at sufficient pressure from the town mains, and is arranged to be self-emptying as well as self-cleansing; the *modus operandi* is as follows:—When the mud cart arrives at the point where the gully is fixed, the man turns back the grate, and opens the water tap, when the mud container rises automatically and tips its contents into the cart, which operation being completed, the water tap is reversed and the dirt container retires to its place, the exhaust water doing duty a second time in cleansing the gully pit. A provision is also made to flush out the container with clean water.

At Southampton, where three miles of air main is laid in the streets in connection with the Shone System of Sewerage, from which service connections can easily be laid on, the waste heat from the combustion of the house refuse in a Destructor being utilized as the motor required for compressing the air, I operate one of these gullies by compressed air.

From the tabulated statement of replies which I received, it

could be seen that in nearly all the towns enumerated, the gully tool mentioned in this paper is the only appliance used, and that once a fortnight appears to be the time for cleansing the gullies, but in some places, monthly.

Movable dirt boxes have been introduced in several instances, this being an advance in the right direction.

Another purpose for which these hydraulic, and I may also say pneumatic, gullies may be used, and which will especially commend them to those who are responsible for the cleansing of roads, is their capability of taking up quickly and cleanly, and discharging directly into the carts the slurry swept from off the roads, thereby obviating the accumulative sweepings remaining in the streets, and the manual labour required for scooping up and throwing this liquid mud unprotected into the carts, which is now the common practice, often resulting in annoyance to the public. These gullies therefore become an excellent adjunct to the horse sweeping machines, and tend greatly to reduce the number of their attendant carts, consequently enabling more work to be performed by them. When required for this service the gullies can be obtained of suitable dimensions with specially arranged tipping gear, and placed in the roadway or other places at convenient intervals for the purpose of the work.

My researches also lead me to the further conclusion that it may be possible in a general system of rainfall drainage for towns, instead of constructing large gullies of the catch-pit type now in general use, to put down small chambers about two feet square and twelve or eighteen inches deep, covered with ordinary iron grating in the channel, and connections with stoneware pipes, unobstructed by traps, direct to a main rainfall sewer, which may at any convenient place be intercepted by one of the self-cleansing street gullies, of suitable dimensions, and the combined contents of the several chambers received into it and discharged at one operation. This arrangement would be found very convenient in places where a cluster of gullies are necessary, as for instance, a circus, or any place formed by the junction of several streets.

Another appliance (which was shown by a full size working model) has been devised for use in towns where water or air motor cannot be obtained.

The casing for the hydraulic gullies I have constructed of concrete, made in moulds to the dimensions required, with clinkers from the Refuse Destructor mixed with a proper proportion of Portland cement.

CONFERENCE OF SANITARY INSPECTORS.

ADDRESS

BY

PROF. A. WYNTER BLYTH.

PRESIDENT OF THE CONFERENCE.

The Sanitary Institute has at length attained its proper position. It is confessedly the chief society in the kingdom having for its main object the furtherance of all knowledge relating to the prevention of disease; it watches over and promotes health legislation; it encourages and rewards invention, by its museums, by its exhibitions, and by its congresses; but, according to my idea, its chief claim for continued and prosperous existence is its great services in hygienic education. The Institute is the first body which ever organized permanently educational lectures with the express purpose of giving the necessary technical knowledge to inspectors. These educational courses have not been confined to the metropolis, but have been established in nearly all the great population centres, and most of the County Councils have been induced to set aside a portion of the educational grant for that purpose; nor have the advantages been confined to inspectors. In each instance a fair number of the general public has attended. The results of this general diffusion of accurate knowledge on the prevention of disease are incalculable, for the fact cannot be too widely accepted, that sanitary laws in advance of the average mental culture of the people are so many dead letters. In Russia, in Turkey, in Spain, and many other parts it would be quite possible to enact laws superior to our own with regard to the prevention of disease, but the sanitary condition of the countries would not be improved to a great extent; for hygiene begins in the household; it must be imparted by parent to child; its precepts must be lisped at the mother's knees, and piped in infant school; then, and then only, will the sanitary officers of any country get the hearty co-operation of the people. The Institute was also the first body to give practical

embodiment to the idea that candidates for the post of inspector should be tested by examination; it is at present the only body the certificate of which is recognized by the Local Government Board. It is a matter of general knowledge that other examining bodies are in existence; as yet they have not received official sanction, and whether they will receive it I know not; but from the history of the medical profession this fact can be learned—that it is not to the interest of inspectors to multiply examining boards. There are some thirty or forty bodies which are capable of granting a legal qualification to practice medicine in the three kingdoms; the result is that a young medical man thinks he is bound to multiply his degrees; he is not satisfied with the qualification of the physicians and surgeons, but considers that the more letters he has after his name, the better the chance of practice or of appointments. He passes a great portion of the best years of his life in studying for examinations, and spends no small portion of his substance, the final result being neither to the advantage of himself nor to that of the community. The only class of persons who are benefited is the class of professional examiners. Speaking as one of the class of examiners, it is to my personal interest to promote and foster the multiplication of all examining boards; but speaking as one of the class of sanitary inspectors—for each health officer, by virtue of his office, is a sanitary inspector—I declare no less emphatically that this multiplication is against the best interests of the sanitary inspectors. How the medical student sighs for the one portal system, and how the medical profession, as a whole, has endeavoured, and endeavoured in vain, to evolve one examining body from the chaos of qualifying bodies is to be read in the medical history of the last ten years.

Should the inspectors sacrifice their interests to satisfy the restless ambition of a few discontented spirits, it is easy to forecast the result. Within a little time there will be some dozen examining bodies, and the ambitious inspector will not be satisfied with the certificate of one of them, but he will, like the young medical man, take two or three, this being a mere question of money. The certificates themselves will be unequal in value, some, as in the analogous case of medical degrees, will be of high value, others of low value; but neither the public nor the local authorities will appreciate these differences. A man holding a certificate of the lower kind will be equal in their eyes, so far as qualification goes, to the certificated man who passed through the examination of the stricter. Besides which the multiplication of examining bodies has of itself a tendency to increase the number of certificated men; and the

greater the number of certificated men, the greater competition for appointments, and the greater the competition, other things being equal, the lower the salary. The progressive stiffening of the Institute's examination has had the good effect of greatly diminishing the number of applicants for an advertised berth. In the old days every clerk, plumber, builder, and out-of-work loafer would answer an advertisement, but the condition enforced by the majority of local authorities that a man must have the certificate of the Institute has altered all this. Now the local authority, thanks to the Institute, has only to select the man whom they think most suitable from a comparatively-speaking small and select body.

Having been placed by virtue of a qualifying examination on a similar basis to that of the pharmaceutical chemist, the modern sanitary inspector has a definite position to maintain; in his hands, to a great extent, lies the future of the public health service, and therefore I will next make a few observations on the subject of "conduct." In the sense I am using the term "conduct," it is almost synonymous with "manners." Conduct is distinct from ability, and from even morality. Talent is an endowment at birth, which may be cultivated, but never acquired. Good or bad morals are also, to a larger extent than teachers of religion will allow, engrained and built into the system; the possession of ancestors, the majority of whom have been good and virtuous, who have had healthy minds and healthy bodies, is a gift of value unsurpassed. But good manners are capable of being acquired by all, and a man is judged by those with whom he comes into casual contact in the daily routine of duty almost entirely by his courtesy or otherwise. Whether the large powers of entry into the Englishman's castle, and the powers of interference with personal liberty of the subject which the inspector possesses, can be beneficially increased will depend upon the conduct of inspectors individually and collectively. Power can only safely be given to those who prove themselves fit to exercise it. Of all nations, the English are most tenacious of the principle of the privacy, even the sanctity, of the home; and this principle is outraged if an official enters without knocking, without permission, and with hat-covered head. Let a home be a room with dirt-begrimed windows, tenanted with squalor and misery, the furniture a broken chair, the bed a heap of rags, yet I advise inspectors, as a matter of policy, to use due ceremony on entering, such as they would on entering the threshold of the clean and wealthy. Emerson took his hat off to a flower as the emblem of beauty, and an outward sign of homage may well be given, not out of respect to the rags or the

squalor, but as a recognition of the principle of home sanctity. The propriety of a silent tread and soft voice in the presence of sickness or sorrow is too obvious to need more than mention. Speech is silver, silence is gold, says the proverb, so it is only exceptional that an inspector requires to harangue sinners against statute or bye-law. His duty begins with observation, it ends with report. Censure where there should be commendation, abuse from owners, temptation from those who would veil bad material or work with a bribe, and, worse than all, false accusation, are troubles some or all of which the inspector is likely to encounter, and demand the exercise of the utmost patience, the utmost self-control. A man's temper is not always self-governable, but self-control by continual exercise can be certainly improved. In a dispute it must be remembered that the man who preserves, has an advantage over the man who has lost, his temper, similar to the advantage of a sober over a drunken man. If the softer answer that turns away wrath prevails not, take refuge in silence, for it takes two to quarrel. The inspector's qualities are sorely tried by "accusation." I regret to remark that the majority of local authorities have shown themselves incapable of making just inquiry into charges against officers. Whenever a local authority has to investigate a charge so serious that it may involve loss of character or office, the authority is practically a court of justice, and should never forget the elementary principles of justice, viz., that the charge should be definite, not general and indefinite; that the accused should have a copy in writing of the charge; that he should be present during the whole time that witnesses for or against him are examined; that he should have an opportunity of cross-examining the witnesses, and ample facility for preparing his defence. So little have these principles been followed, that it has happened more than once that a local authority, actually in the absence of the officer, has investigated a charge, considered it proved without hearing the other side, and passed a vote of censure.

On "The Propriety of Organizing Sanitary Inspectors or Inspectors of Nuisances who are the Holders of Recognized Certificates," by W. Parsons.

ABSTRACT.

Mr. Parsons' reference was made to the requirements of the London Public Health Act, and particularly to that portion providing that Inspectors should be the holders of a certificate

approved by the Local Government Board; and that since the passing of this Act the Sanitary Institute had been recognized as the examining body.

A meeting was convened in April, 1892, at which the following resolutions were passed:—

"That whilst recognizing the parental care other examining bodies desired to offer the Sanitary Inspector, we are of opinion that The Sanitary Institute is quite capable of completing the work it originated, and that we feel ourselves indebted to that body as the pioneers of granting certificates, and for the noble work they have already achieved in not only raising the status of Sanitary Inspectors, but in studying the interests of the public generally; and their certificate is definitely recognized by no less than twenty-seven Metropolitan Local Authorities, seventy provincial, and one colonial; and that an institute be formed and designated the Institute of Certificated Sanitary Inspectors, the objects being to raise the status of certificated Sanitary Inspectors, and to devote itself to the advancement of Sanitary science and the dissemination of Sanitary knowledge among its members and the general public."

"That the Institution consist of Fellows, being persons of distinction and scientific eminence; Members, who hold, or have held, public appointment for three years and upwards, and possess the recognized Certificate; Associates, holding public appointment for a less term and holding Certificate, who shall be eligible for Membership after having held office for the qualifying period, or those holding Certificate and not a public appointment, upon the production of two testimonials, to be approved."

Mr. Parsons then explained that the Institute of Certificated Sanitary Inspectors had received in response to a memorial presented, the recognition of the Sanitary Institute together with other privileges. He dwelt on the great advantage arising from the blending of theoretical with practical knowledge of Sanitation, and its necessity as a qualification of competency.

"*Difficulties in the Prevention of Infectious Disease,*" *by* S. C. G. FAIRCHILD, Sanitary Inspector, Clapham.

ABSTRACT.

ALTHOUGH considerable progress has been made in the protection of the public by the passing of The Infectious Disease

Notification Act, The Disease Prevention Act, and The Public Health (London) Act, there are details in the working of these measures which, if not carried out promptly and thoroughly, take from the public that protection intended to be given.

The section dealing with notification of infectious disease by the head of the family, &c., is seldom carried out in many districts, thereby a loss of time takes place before any steps can be taken by the Sanitary authority; for it frequently happens that several hours, if not a day or two, elapse before the notification from the medical practitioner in attendance is received by the Medical Officer of Health; during this time the patient may have been in contact with the other members of the family without anything being done towards isolation. Nor is it possible to prevent children from going to school. If every Sanitary authority insisted upon the notification from the head of the family a large number of cases of infectious disease would be prevented.

The regulations of the Educational Department in connection with school attendance affecting the teachers' reputation, some teachers resort to all manner of expedients to get the children to school with little regard to the dangers that may arise, and occasionally parents deliberately send their children to school from infected houses.

One of the difficulties to contend with is the opposition of some people to the hospital. Patients are kept at home in houses that are totally unfit for the purposes of separation, nor can the inmates always be trusted to carry out anything like proper isolation; and it is to be regretted that there are a few medical practitioners who do not use their influence to assist the sanitary officers.

It would greatly assist in carrying out disinfection if the medical gentleman attending infectious cases kept at home, was obligated to notify the recovery of the patient.

In disinfecting it is impossible to be always certain that every infected article is placed in contact with the vapours in use. Many persons believe that disinfection means destruction, consequently many infected articles are purposely removed.

Many of the difficulties in the prevention of infectious disease are simply the result of ignorance and prejudice, and may be remedied in a few years by making Hygiene a compulsory subject in every school throughout the Kingdom.

On "The Sanitary Institute and its Relation to Sanitary Inspectors, with a Resolution," by W. H. Wells.

ABSTRACT.

In addition to admitting Sanitary Inspectors to an active part in the work of the Congress, I propose briefly to indicate some further steps which I consider the Institute should take in the interest of the Inspector and his work.

1. Membership of the Institute should be open to the Chief Inspectors of the large cities and towns, and to elect representatives of the various associations of Inspectors in the kingdom.

2. That at least two seats on the Council of the Institute should be provided for and occupied by Inspectors.

These two propositions aim at providing a channel along which the views of Sanitary Inspectors could be conveyed to the very heart of the Institute.

3. That certificates of a higher grade be established. With the present certificate men of great experience and ability rank no higher than the mere novice fresh from the cram. The addition I suggest would result in elevating the status and dignity of the Sanitary Inspector, attracting all as it would, to a continued effort of self-improvement, and bringing out into prominence from the rank and file those men who by their ability and perseverance render themselves worthy of the distinction.

It has been stated by some that the Inspector has too much to do; I am not of that opinion, and to my mind the fact that so much is required of him does but indicate how useful to the local authorities, and ratepayers generally, the Inspector can be. I strongly deprecate any suggestion for narrowing the field of his labour, nay, rather I would increase it still more by making him responsible for the efficiency of the drains and sanitary fittings of all new houses, and place under his supervision the scavenging of the streets, collection of house refuse, and management of the destructors. The advanced certificate I propose should not only require a theoretical acquaintance with these latter duties but a sound practical knowledge, only to be gained by actual experience.

4. That the Institute, prior to each Congress, issue a circular to every local authority, requesting them to send their Inspector of Nuisances to the meeting and pay his expenses.

If the Institute is to do all the educational good it can it should, in addition to its other functions, aim at gathering

around it once a year all the Health Officers that circumstances will permit of being spared for a week from their duty.

I suggest this in the hope that something practicable may be done in the direction of enabling those to attend whose far too meagre salaries at present prevent their so doing. It cannot be said that so small a charge would be improperly laid upon the rates, as all increase in the efficiency of a Health Officer is reflected directly in good upon the ratepayer, and if national health has any money value at all, no reasonable cost should be spared by the nation in increasing the opportunities for the technical and scientific education of those upon whose advice the nation relies, and I do not hesitate to give a high position amongst this group of public officers to the humble Inspector of Nuisances.

5. The last and most important suggestion of all which I have to make is that The Sanitary Institute should undertake, through the proper channel, to induce the legislature with all possible speed to codify, simplify, and otherwise improve and extend the Sanitary law of the kingdom, as applied at any rate to England and Wales.

Lawyers who have at different times to plead on both sides of a question may rejoice in double meanings, argumentative definitions, and multitudinous piecemeal legislation, but from our point of view these things are to be deplored; the Sanitary law of the land is a disgrace to a country professing to lead in such matters. The anomalies, shortcomings, and contradictions in our Sanitary statutes are patent to all of us, and yet we sit with folded hands praying for some one to do something, and feeling thankful and hopeful when a disjointed fragment or two of improvement is now and then thrown to us, whilst we make not the slightest apparent combined effort to force on a radical reconstruction of the entire book.

The latest effort, the Public Health Act of 1891, was confined in its application to London, thus legislating for a portion of the country only, which is another incomprehensible feature in the wisdom of our law-givers. Why are we all so hungry, so patient, so dependent, and so helpless? We have by this time had experience enough to know fairly well what this country needs in the way of Sanitary legal powers, and we, with the town clerks, the surveyors, the medical officers, and with the Sanitary Institute at our head, possess the brains from which the needed reformation should in the first instance evolve. Surely our members of Parliament are not pedestalled aloof from a personal knowledge of our country's need in this respect, or is it that when in remote moments of zeal for the country's hygienic weal they call around them in secret corners advisers

of narrow vision, as the slow, jerky, and imperfect additions to our Sanitary law would imply?

I believe that our legislators are ever ready, Ireland notwithstanding, to give prominent consideration to the health laws of our land. The fault that it is not successful lies at the feet of our local executive officers, who inanely grumble and struggle on, attempting to combat disease and death by the aid of a little law, much exercise of persuasive genius, and terrorising the ignorant with an exhibition of assumed power. This is far from being as it should be; tact, persuasion, and the power to morally convince, should always be to the fore, but the strong clear authority of the law should ever be behind to support the efforts of the sanitary officer, and who more clearly than he who has experienced rebuffs and defeat, can point out the weak places which need the support of legal power?

My proposition in this regard is, that the Sanitary Institute call around it men well versed in the execution of existing statutes, and after accumulating and discussing the various points involved, formulate a comprehensive draft of such an Act as will, so far as possible, remove all existing anomalies, contradictions, weaknesses and difficulties, and for the Institute to do its utmost to obtain the enactment thereof.

I propose the following resolutions that The Sanitary Institute be requested to consider:—

1. The admission of Sanitary Inspectors to the membership of the Institute.

2. The admission of Sanitary Inspectors to the Council of the Institute.

3. The establishment of a Certificate of Competency for Sanitary Inspectors of higher grade than the present one, and its division into three classes—2nd, 1st, and Honours.

The present Certificate to be styled Elementary.

4. That the Institute request each Authority at its own cost to annually send to Congress its Inspector of Nuisances.

5. That the Institute form a committee for the drafting of a Model Sanitary Statute, and do all in its power to accomplish its enactment. Said committee to include, by invitation of the Institute, such Local Government Officers in England and Wales as would in their opinion be useful, whether such officers are members of the Institute or not.

Resolution No. 3, after a full discussion of the subject, was not carried; for other resolutions see page 346.

"*Superannuation for Sanitary Inspectors,*" *by* J. L. Bell.

I am fully aware that the subject of Superannuation has been brought forward on more than one occasion, but at the same time I consider it such a vital question that it should not be allowed to drop.

If any one is, or any body of men are, entitled to be considered in their old age, I contend it is the Sanitary Inspectors.

The officers and men of the army and navy are entitled to pensions on completing their term of service, yet the Sanitary Inspectors have nothing to look forward to when they are no longer able to work.

They are surrounded by as many dangers as our fighting forces, dangers which cannot be seen to be grappled with. In giving advice in houses where some virulent disease is prevalent, or inspecting a district where some dangerous disease is epidemic, or in removing patients to hospital, oftentimes carrying them in their arms some distance, and then nursing them in the ambulance, these, I say, place the lives of Inspectors in as much jeopardy as a soldier on a field of battle.

Then why should the officers in the Civil Services be entitled to pensions? their duties are not harder or more dangerous than an Inspector's, and their pay is better. It is simply the fact that they are Government servants.

Again, look at the officials under the Poor Law Board; they are entitled (on the recommendation of the Guardians and the approval of the Local Government Board) to pensions or superannuation. Surely an Inspector, or say any official under a Local Authority, after having spent the best years in its employ and being too old for work, ought to be able to resign and receive some recompense for his length of service. Masters of Workhouses (whose lives, as a rule, are far more happy than an Inspector's) with nice quarters to live in, good food, &c., and plenty to wait on them, collectors, relieving officers, drill masters, porters, &c., they, if they behave themselves, are sure of being provided for when old age creeps on. I have never yet been able to see where the difference comes in between an official under the Poor Law and one under a Corporation, excepting that the Poor Law official is the more favoured of the two.

Again, officials under the Lunacy Law are given pensions by the County Councils or Courts of Quarter Sessions.

With regard to the Police Force I have nothing to say against their Superannuation, as they contribute to the fund a portion of their own salaries. Their widows, too, are somewhat

provided for, for in case of death the widow, in some instances, obtains one year's pay. Whoever heard of an Inspector's widow being paid a year's salary if perchance the husband contracted in the execution of his duty, say, cholera, small-pox, or diphtheria, and died from the effects of it.

I propose that a deputation should be formed to wait upon the Local Government Board to urge our claims to pensions, and also the desirability of our being appointed immediately under the control of the Local Government Board.

In the event of our not succeeding in getting direct superannuation, I would suggest that a fund should be formed to which the Inspectors should pay a part, and to which it should be compulsory for Local Authorities to contribute.

Mr. Boulnois, City Engineer for Liverpool, in his Municipal and Sanitary Engineers' Hand-book, has sketched a scheme for the superannuation of Municipal officials; the principal points are as follows:—

(1) Officers to pay into a fund $3\frac{1}{2}$ per cent. of their salaries.

(2) Corporations to pay $1\frac{1}{2}$ per cent., and to allow $4\frac{1}{2}$ per cent. compound interest.

(3) Superannuation to be on a fixed scale, say $\frac{1}{60}$ of average salary for the last ten years, multiplied by the number of years' service. The officers to retire at sixty years of age.

(4) In case of death before superannuation, his representative to draw the amount standing to his credit.

(5) In case of voluntary resignation, the officer to withdraw the amount standing to his credit without interest.

(6) In case of dismissal, the officer to withdraw his own money contributed, but not the Corporation money or any interest.

(7) In case of dismissal for fraud the whole to be forfeited.

(8) In case of long illness, advances to be made not exceeding one-fourth of the sum standing to the officer's credit; this sum to be repaid before a second advance be made.

If this scheme, or some modification of the same, was to be made compulsory, it must result as Mr. Boulnois says, in a better feeling between officials and employers, with the probability of the best officials being retained, as they would have a sum of money at stake with the Corporation, which was increasing every year.

Officials would also be relieved of anxiety and care for the future, and additional security would be ensured in case of fraud by an officer.

The Corporation of the City of Manchester has devised what is called a "Thrift Fund," which is on very similar lines to Mr. Boulnois' scheme. The officials in this case pay into the fund $3\frac{3}{4}$ per cent. on their salaries, and the city $1\frac{1}{4}$ per cent., on which the Corporation allow interest and compound interest at the rate of 4 per cent. At the age of sixty-five years the official may retire and withdraw the amount standing to his credit, with interest and compound interest at 4 per cent.

I find if a man is appointed, say at the age of thirty, at a salary of £100 per annum, and paid into this Thrift Fund till he was sixty-five years of age, he would be entitled to retire and take the amount standing in his name, which would be about £380. Of the two schemes I have mentioned, in the place of direct superannuation from the Local Government Board, I consider Mr. Boulnois' scheme the best, and I see no reason why it should not be successfully worked.

In conclusion, gentlemen, first of all we must be *united*, for without union I am afraid we shall never get superannuation; secondly, we must not cease agitating until we have brought our claim prominently before every Member of Parliament.

For Resolutions passed at this Conference, see page 346.

CONFERENCE OF LADIES ON DOMESTIC HYGIENE.

ADDRESS

BY

MRS. ERNEST DAY.

Deeply sensible as I am of the honour which the Committee of the Sanitary Institute have conferred, in asking me to preside at this, the first meeting of ladies, held in connection with their annual Congress, it is with unfeigned regret that I occupy the position which we all hoped, none more sincerely than I, would have been filled by a lady in every way more worthy to be your President. It is only in the unavoidable and much-to-be-deplored absence of Lady Douglas Galton that I have consented, as her deputy, to do my utmost to fill her place to-day, encouraged in my effort by the thought that I am carrying out her wishes, and merely taking up the threads of a work with which she has all along been closely identified, and to the preliminary and important stages of which she has devoted her valuable judgment and experience.

Indeed, my only excuse for venturing to appear even in the character of a deputy-president is the great interest which I feel in all that concerns domestic hygiene. I am here as one most earnestly anxious to learn from those who have been good enough to promise to address us, ways of promoting the cause of health. Questions will be discussed to-day on subjects of the deepest import to us as women and as citizens.

Much has been done since Miss Nightingale, whose home in your county makes her in some sense a local as well as a universal benefactress, first introduced into hospital and home, nursing principles and sanitation, until then hardly understood and certainly not practised, followed by Kingsley, who more than thirty years ago spoke to the members of the "Ladies' Sanitary Association" on the subject of preventible infant mortality as "The Massacre of the Innocents." We shall hear this morning what Dr. Freeman now thinks to be the hygienic cause of the still terrible, if decreased, infant mortality.

Closely allied to the loss of our loved ones comes the question of food, especially with reference to the sick, about which we are to be told by Miss Lamport.

Conspicuous amongst the means for keeping us in health must be considered ventilation, which will be brought before us by Miss Barrett; while the not less important point of exercise, in its physical and mental aspects, will be treated of by Miss Charlotte Smith.

I hope this afternoon to suggest some of the ways in which we may become missionaries of health to our less instructed sisters; while Dr. Schofield, who has already devoted himself so ably to our advancement in the science of hygiene, will speak with the authority which his professional experience gives, of the value to us of such knowledge.

For many years past these annual Congresses have been held by the Sanitary Institute, each one marking a step of progress in the sanitary reforms of our country. But this is the first occasion upon which women have been invited to take any prominent part in the conference, though individual exceptions have occurred from time to time. It rests with us to make the best possible use of this opening for co-operation, and not allow it to pass by in unproductive talk. The wisest counsels will fail to bring forth good results if not put into practice; the most beneficent sanitary legislation will be ineffectual if allowed to become a dead letter, as it will surely do if women are not prepared to go hand in hand with men in carrying out the laws of health in the home. This is so essentially the woman's province that, unless we are willing to recognise our responsibilities, we are actual hinderers instead of helpers.

I rejoice greatly that we have been called upon by the Institute to take up our share in their noble work.

We cannot face the difficult problems of modern civilisation with its overcrowded houses, contaminated air, polluted water, adulterated food, unhealthy dress, and overstrained nerves, without wishing to do our small part as units in the great aggregate towards physical reformation. By our abuses God's best gifts have been perverted, and what was freely bestowed on all, is enjoyed only by the few.

Let us, therefore, gladly avail ourselves of this opportunity of learning from one another, and from those who are especially well qualified to teach, with full purpose to make practical and personal amendment; for, however widely our hygienic reforms may spread, I think we shall all agree that they should commence in our own homes, and for the benefit of our husbands and children. Not until each home is a centre from which will radiate perfect love, and perfect purity, can we consider that our work is accomplished.

On "Food with special relation to the Sick," by ETHEL LAMPORT, Lecturer on *Hygiene and Sick-nursing* to the Ladies' Sanitary Association.

ABSTRACT.

TWO chief points to remember with regard to Food for the Sick are that it need not be unpalatable, and that it need not be monotonous.

The difference between the food required by the healthy, and by the sick.

Patients must only have as much food as they can digest.

In all febrile diseases the mouth should be cleansed with non-poisonous disinfectant before food, the hands and face washed, and the patient made generally cool and comfortable.

Suggestions for invalid food so as to get as great a variety as possible.

The digestion of certain kinds of food, whether rapid or delayed, must be taken into account on drawing up a sick diet.

On "The chief Hygienic causes of mortality amongst Infants and young Children," by J. P. WILLIAMS-FREEMAN, M.D., Lic. San. Sci.

ABSTRACT.

THE four chief causes of death in children under five years are:

(1.) Diseases of respiratory system.
(2.) Diseases of nervous system.
(3.) Diarrhœa.
(4.) Whooping cough.

Each cause is most active amongst infants under one year, and diminishes with each year of life.

Brief discussion of œtiology of each group, with special Hygienic means of prevention.

General hygiene of infancy and childhood must be based on knowledge of natural history of the child.

The child's position in the evolution of man must be the constant guide to a proper hygienic environment.

On "The Need for Fresh Air in Modern Houses," by Edith A. Barnett.

ABSTRACT

The characteristics of modern life are :—

I. Town, not country.
II. Greater number of hours in artificial light.
III. "Better" building.
IV. More luxurious fittings and accessories.
V. Greater proportion of indoor employments.

That to breathe fresh air is necessary no one denies, and the breathing of fresh air is impossible, unless :—

1. Certain *space.*
2. *Inlet* of fresh air.
3. *Cleanliness.*
4. *Sunshine.*

Space.—Town populations constantly increase; town rents constantly rise. Tendency to devote best rooms to show: *e g.*, flats. Children's rooms, servants' rooms, bedrooms. Already limited space blocked with furniture and hangings. Increased luxury in dress necessitates space for storage. Space round the house often *nil:* where there is a garden it is unused, town dwellers having an insane fear of being overlooked.

Inlet.—Still more insane fear of through draughts; supposed to be genteel to live shut up. In average town houses doors and windows all closely shut. Oscillation between fixed ventilators and open windows: *both* necessary. Draughts often dreaded, because they endanger the ornaments and blow the hangings about.

Inlet through walls avoided by "better" building. Anæmia among country poor. Hatch-doors universal in cottages and farm-houses a generation ago; now heavy front doors carefully shut. Inlet of foul air by modern drainage arrangements, especially when added on to an old house.

Cleanliness made more difficult by our modern furniture. Upholstered furniture, hangings, bows, screens, &c., on walls; all so many dust-traps. Taken in connection with the servant difficulty, and more luxurious habits in eating, the result is want of cleanliness in nine houses out of ten. Advantages of polished wood furniture. Bed-hangings gone out, but in their stead curtains, screens, draperies without number. Ornaments and nick-nacks hold dust; dust in inhabited houses means decaying animal organic matter.

Cleanliness of persons as well as things. Opportunities for bathing not a class question.

SUNLIGHT is carefully shut out of the modern house. "Dim, religious light." Mrs. Skewton's pink curtains. Even if we prefer sunshine, our cherished "things" do not like it; they fade if they are new, look shabby if they are old. Spare cash is scarce, and to save our pockets and our friends' criticism we pull down the blinds. The gentility of sitting in the dark.

Number of hours by lamp and gas-light: a notable alteration for the worse during the last twenty years. Evening entertainments are modern contrivances. Gas *v.* candles. Products of combustion, light for light; night-lights unnecessary in days of matches.

The conclusion of the matter: a fashion to be set.

On "Our opportunities of spreading Knowledge of Hygiene to Women and Girls," by Mrs. ERNEST DAY.

ABSTRACT.

Value of hygienic knowledge to women; how the untrained may obtain it.

Desire to spread the knowledge to those less instructed.

Example stronger than precept; woman neglecting the sanitary condition of her own household, the health of her dependants, physiological laws in regard to her own dress.

Existing organisations for the dissemination of such knowledge. (*a*) Mothers' meetings, infantile mortality, cleanliness, food, hints on cookery and nursing, simple illustrations from known to the unknown. (*b*) Girls' clubs and G.F.S. Rooms, workers in factories, ventilation, personal cleanliness. (*c*) Sunday school classes, prevention of contagious diseases.

Advantage of some elementary training in hygiene and domestic economy to the pupils and teachers in Board and National schools.

Desire to make it compulsory. Cookery encouraged, hygiene omitted, laundry work commenced; illustration Leeds Board Schools.

Its value as part of night school code, future generation.

Middle Class, High Schools and Colleges practical hygiene, gymnastics, theoretical teaching not general. Ipswich High School. Science and Art examinations; physiology, interesting study, appropriate; God's laws, physical and spiritual.

On "Physical and Mental Effects of Exercise," by CHARLOTTE ALICE SMITH, Undergraduate London University.

ABSTRACT.

1. Effect of exercise on (*a*) body, (*b*) mind, (*c*) morals.

2. Diseases and alterations of brain cells favoured by deficiency.

3. Nutrition and the functional vitality of the tissues dependent on the supply of oxygen of fresh air.

4. Non-development of body and mind with reference to criminals and idiots.

5. Views of European nations and various specialists, with extract from Dr. Blatin's speech before the French Chamber of Deputies.

6. Hygiene in girls' schools, and modes of exercise, with bodily and mental effects.

7. Grecian views on the subject of development.

8. A few simple rules for adult exercise.

On "The Necessity of Home Education in Hygiene," by A. T. SCHOFIELD, M.D.

ABSTRACT.

THE present position of woman in hygienic knowledge and practice as compared with the middle ages when her knowledge of other arts and sciences was far smaller. The value of the study to women generally for their own sake and for others.

What is included in the word hygiene within the *housewife's* sphere with regard to physiology, anatomy, nursing, home sanitation, ventilation, food, cooking, &c.

Within the *mother's* sphere in forming intelligent hygienic habits in children in the nursery, play-ground, and schoolroom, teaching them how to care for their own and other children's health with regards to bath, draughts, woollen clothing, for games, their postures, &c. From the age of three or four, children are interested in knowing the why and wherefores of things that are arranged for them, and the practice of the laws of health at that age soon becomes habit.

Within the *mistress's* sphere, in training servants who will make other homes and centres of hygiene, or of unhealthiness.

In the *nurse's* sphere where she may make it the surrounding influence of the children's life, at a time when they have much leisure and are always absorbing new ideas.

In the *teacher's* and *governess's* sphere, when the knowledge that is given with authority and tabulated by the children for future reference and use.

In the *invalid nurse's* sphere, where the teaching is so practical and efficient, that it rarely fails to inspire the patient with a love of hygiene for its own sake. As in the *district visitor's* sphere where the "sweet reasonableness" and sympathy of woman is so heavily taxed, but where so slowly it greatly convinces the poor that, through hygiene beauty and strength are for them as truly as for the great.

RESOLUTIONS PASSED AT THE CONGRESS HELD AT PORTSMOUTH, 1892.

During the Congress certain resolutions were passed at the various meetings, and were in due course submitted to the Council of the Institute. After careful consideration certain decisions were come to by the Council, which are set out below following each Resolution.

As the various meetings at which the Resolutions were passed cannot now be informed of the action taken, the Council thought it well to set them out here for the information of those interested.

Resolutions passed in Section 1.—Sanitary Science and Preventive Medicine.

1. "That Section I. is of opinion that in towns with populations of over 20,000 inhabitants, private slaughter-houses should be totally abolished and be superseded by public abattoirs under the control of the local authorities."

Resolution of Council:—"To forward the resolution to the Local Government Board with the approval of the Council suggesting that compensation should be provided for."

2. "That in the opinion of Section I. the execution of the Vaccination Acts should be transferred from the Poor Law Board of Guardians to the Sanitary Authorities, especially in large towns."

Resolution of Council :—"To take no action."

Resolution passed in Section II.—Engineering and Architecture.

3. "That in order to prevent the increasing pollution of rivers by manufacturers' refuse, enlarged powers should be given to local authorities to compel the offenders to purify the polluted waters, and in default the local authority should have power to carry out the necessary work at the cost of the offenders."

Resolution of Council :—"To forward the resolution to the Local Government Board with the approval of the Council."

Resolutions passed in the Conference of Medical Officers of Health.

4. "That it be a recommendation to the Council of The Sanitary Institute to urge upon the Local Government Board the policy of special expenditure upon cholera precautions and cholera isolation hospitals incurred by Port Sanitary Authorities as the country's first line of defence, being borne by Imperial funds and not by local rates."

The following recommendation was adopted by the Council :—"That it would be impossible logically to limit this policy to Ports, and if Imperial funds are to be spent by Local Authorities they must be under Imperial control."

5. "That it be a recommendation to the Council of The Sanitary Institute to urge upon the Local Government Board the necessity of a census being taken every five years."

By direction of the Council, a communication to this effect was sent to the Local Government Board.

6. "That in the opinion of this Conference of Medical Officers of Health, where tuberculosis of a single organ of the body is associated with impairment of the nutrition of the flesh, the whole animal should be condemned, and that where tuberculosis affects more than one organ, or where serous surfaces are extensively implicated, the whole animal should in all cases be condemned."

The Council thought it desirable that as there is a Royal Commission appointed to consider this subject, the Institute should defer action until this Commission has reported.

Resolutions passed at the Conference of Sanitary Inspectors.

7. "That this Meeting is of opinion that the removal to an isolation hospital of all persons, irrespective of social status, who are not, in the opinion of the Sanitary Officers, effectually isolated, should be made compulsory."

The Council consider that this is practically the present state of the law.

8. "The admission of Sanitary Inspectors to the membership of the Institute."

There is nothing to render Sanitary Inspectors ineligible as candidates for membership.

9. "The admission of Sanitary Inspectors to the Council of the Institute."

The Articles of Association provide that all members who come under the definition in the Memorandum relating to

Fellows are eligible for nomination for the Fellowship, and that Fellows may be nominated Members of Council.

10. "That the Institute request each authority at its own cost to annually send to Congress its Inspector of Nuisances."

Complimentary Tickets are sent to Local Authorities, asking them to appoint delegates. Some authorities have appointed Inspectors as delegates, and the Council would also be glad to learn that the Local Authorities paid the expenses of their Inspectors, but the Institute is hardly in a position to ask them to do so.

11. "That the Institute form a Committee for the drafting of a Model Sanitary Statute, and do all in its power to accomplish its enactment. Said Committee to include, by invitation of the Institute, such Local Government Officials in England and Wales as would in their opinion be useful, whether such officers are members of the Institute or not."

The following recommendation was adopted by the Council:—"That in the event of the Institute being in a position to undertake such a responsibility, they should not lose sight of the subject."

12. "That a deputation be formed to wait upon the Local Government Board to urge our claims to pensions, and also the desirability of our being appointed immediately under the control of the Local Government Board."

"That a Committee be formed to consider the subject of superannuation, and to approach the Local Government Board."

The Council consider that Pensions are mainly questions of political economy, and the intervention of the Institute would hardly be likely to advance the objects which the Inspectors have in view. With reference to Inspectors being directly under the control of the Local Government Board the Council hold that in the interests of sanitation it is desirable that they should not be liable to dismissal or reduction of salary without the consent of the Local Government Board.

ENGLISH HOMES.

LECTURE TO THE CONGRESS,

BY

Sir THOMAS CRAWFORD, K.C.B., Q.H.S., M.D., LL.D.

The objects for which The Sanitary Institute has been established have been so frequently and lucidly set forth in addresses, delivered from time to time at these Congresses and published in our Transactions, that this aspect of the duties devolving upon the Chairman of Council may be briefly disposed of. The Institute is making rapid strides in its development, and the good work done by it in spreading abroad sound views on the principles, and practical knowledge regarding the details of domestic and personal hygiene, is now generally acknowledged. There is still much to be done, however, before the public at large can be brought to see the enormous waste in money, and the suffering and privation entailed upon the people, and most of all upon the poor, by the prevalence of preventible disease. Why is this so? Why should a people, conspicuous for many of the best qualities which contribute to a nation's success, still fall far short of domestic virtues which were successfully cultivated in the infancy of the human race?

Canon Knox-Little lays stress on the fact that there are certain qualities and endowments which are peculiarly the heritage of our race, and which were conspicuous in those northern hordes who contributed so largely to overthrow the Roman Empire. Their sources of strength were truthfulness, plainness and simplicity of life, a strong sense of justice, impatience of affectation and pretence, dislike of exaggeration, and contempt for all forms of sham. "They valued the virtues of purity; the virtues which lead men to respect their own souls and bodies, and therefore the bodies and souls of others; which make friendship noble and enduring, and love ennobling and strong; which feed the fire of true affection between friend and friend, between lover and lover, between child and parent, and parent and child; out of which have been created those 'schools of goodness'—English homes."

Sprung from such men and inheriting such traditions, our homes ought to be considerably in advance of other nations. Are they so? In the imposing mansion in which I write, occupying a conspicuous position in one of the most fashionable inland watering-places in England, a stagnant atmosphere is but too perceptible in the corridors, while a vigorous use of open windows barely suffices to make the public rooms habitable. The picture of our English homes sketched by the Countess de Viesca in a paper read at the Congress at Leicester, and published in the Transactions for 1885-6, shows ample evidence of the pressing need that exists for further improvement in almost every detail of domestic sanitation.

But before discussing these points it may be well to notice briefly, the standard by which progress in sanitation may be best measured. The present practice is to depend almost entirely upon statistics of mortality. A death in a community is a fact which is not open to question, and the aggregate number of deaths in a given population is, undoubtedly, a reliable standard of comparison between one given section of the community and another. The population of Portsmouth, for example, in 1890 was 160,128; the births per 1000 were 34·3 and the deaths 18·9, a ratio which compares favourably with the 31 large towns at home, with which it is usually contrasted. If this mortality was attributable to natural causes, uniform in their operation in all communities, a reliable comparison could obviously be made; but, to quote Dr. Guthrie, "Few people die a natural death. Some are murdered, but the greater part, who have arrived at years of discretion, commit suicide of a sort, through the neglect of the ordinary rules of health, or the injudicious use of meat, drink, or medicine." The "discretion" possessed by those who commit suicide through self-indulgence is not, perhaps, an important factor in the calculation, still the Rev. Doctor's remark must not be overlooked when estimating the extent to which mortality is attributable to preventible causes, whether these be moral or physical. True, the *moral* microbe has not yet been differentiated by the scientist, although the medical practitioner will be the first to admit, with Dr. Guthrie, that the specific microbe would be, in the great majority of cases, harmless, were it not aided and abetted in its onslaught, by some indiscretion on the part of the sufferer.

Again, statistics as usually available are too generalized, to be a safe guide in judging of the sanitary condition of particular localities or dwellings. Groups of residential premises of particular types, occupied by families of equal, or nearly equal social status, furnish a fair standard of comparison; but in a large town like Portsmouth or London, statistics of general

mortality must be carefully sifted and arranged by districts, and even by streets, lanes, and alleys, in order to arrive at safe conclusions. The death-rate among women and children, if compiled by districts or blocks of residential buildings of a common type, and differentiated by ages of occupants, would be less open to objection; but the nature and extent of the sickness among these two classes would be still more reliable, because they are more continuously resident, and because children in particular are more susceptible of injury to health from insanitary surroundings. Sir James Crichton Browne has recently published some valuable observations on the differences of development between the two sexes, and on the injurious effects of over-pressure in schools, but I do not think he has made due allowance for the wide difference in the conditions under which the sexes spend the greater part of their time. Men are undoubtedly as a class much more in the open air than women, and to this is probably attributable the lessened appetites and weaker assimilative powers, which result in a weaker development of the latter.

But the differences between the physical development of rural and urban populations is the best test of surrounding health conditions, and up to the present the advantages are clearly in favour of the country. In both, however, there is evidence of progressive improvement, and this may be approximately estimated by the structural adaptations to be found in residential dwellings of different dates and epochs.

An attentive observer of what is passing around him will have noticed the rapidity with which structural changes in those hives of human industry—large towns—take place. "God made the country, but man made the town," has become a proverb among us, and like man himself, largely modified as he has been by his own action since he left the hand of his Maker, his handiwork, as presented by the earlier editions of our great cities, is by no means perfect. But we are improving. Streets and alleys in our more populous centres, which were the residences of the more cultured classes a century ago, have in many instances, passed into the hands of the speculative rack-renter, to be let out as tenements; while, in not a few, whole districts of such tenements are daily swept away, either because they are no longer habitable, or because they are unsuited to the growing needs of an ever-advancing civilization. But taking our homes as they are, and applying to them the hygienic rules which we know to be sound, and are easily accessible to all, what must be, in too many instances, our verdict? Clearly there is still room for improvement in the best of them.

Assuming that there is nothing structurally objectionable in a house, and that it is considered by the sanitary authorities

habitable, what are the conditions which must be observed if the inhabitants are to have a reasonable prospect of enjoying good health? First, as to externals. The house itself must stand on a healthy site. This consideration is no doubt present to the mind of anyone seeking a mansion, or a house of even much less pretensions, but it is too often altogether overlooked by the cottager; and anyone who takes note of the present system of disposing of so-called rubbish in and about great cities, and the rapidity with which ground made out of what was but yesterday a mere swamp, is covered by cottages, too often constructed without those safeguards devised to protect the inmates from damp and ground air, must see the danger which lurks beneath.

A free supply of fresh pure air is a requisite of first importance, and this cannot be secured unless the surroundings over which it must pass are also pure. Air polluted by emanations from decaying organic matter, is not only offensive to our senses, but also injurious to our health, because deprived of much of its oxygen, and in consequence rendered to a corresponding extent incapable of accomplishing those blood changes which are constantly taking place in the lungs, and without which health could not be preserved. The existence of open spaces in front and rear of every inhabited house, from which a free supply of fresh air can be drawn for purposes of ventilation, is therefore essential. Unfortunately the atmosphere of all large towns contains elements of impurity, such as products of combustion and decay of organic matter, which the dwellers in our cities appear to regard as necessary evils; and till better educated, and more thoroughly alive to the deleterious effects upon the public health of such products, the smoke abatement and refuse removal movements ought to receive every encouragement and support.

There is another aspect in which this subject must be viewed. Sunlight is a most important and essential element in regard to the salubrity, as well as the suitableness of a house for residential purposes. No apartment is really fit for human habitation which is not freely traversed by sunlight. If by the direct rays of the sun so much the better. Those of you who have studied the influence of light on the development of colour in the vegetable, and indeed in the animal world also, need not be told that healthy growth is not attainable without a reasonable supply of that vivifying influence. This requisite cannot be secured without free access through open spaces—a necessary condition apt to be too little regarded by builders, in their efforts to house an undue proportion of individuals on a given space. This subject of surface overcrowding, and undue

elevation of buildings in close proximity to each other, has been so ably treated by Dr. L. Parkes, in a paper published in the twelfth volume of our Transactions recently issued, that I need not follow it further here. The smoke-laden atmosphere of such towns as London, Manchester, and the larger manufacturing centres throughout the kingdom, is in itself such an impenetrable barrier to the free ingress of the sun's rays to our dwellings, throughout the greater part of the year, that we cannot afford to add the avoidable elements of overshadowing of buildings, and overcrowding of surface spaces.

A good water supply is an obvious necessity for every dwelling. The measure of our needs in this particular, and the best methods of providing for them, have been often discussed, but the subject is by no means exhausted. The rapid increase of town populations, and the consequent ever augmenting demands for a supply of this most essential requisite, have forced into prominence the question of water conservancy. What an important part this so-called element plays in the economy of nature, as well as in the life of man! It covers a large part of the earth's surface, and is universally diffused throughout the atmosphere; it drapes the heavens with curtains of the most gorgeous colours dyed in the rosy tints of morn, or in evening's golden hue; and it fills the floating reservoirs of the sky, to descend, when burst by lightning or breaking by their own weight, in refreshing showers upon the thirsty ground. And when it has so descended and refreshed the earth, it forms itself into rivulets and brooks, which, swelling as they proceed, bring health and gladness to our villages and towns scattered along their banks. It may, indeed, be truly added, in Dr. Guthrie's own words, "the circulation of this fluid is to the world what that of the blood is to the body, or grace to the soul. It is its life. Withdraw it, and all that lives would expire; forests, fields, beasts, man himself would die. This world would become one vast grave; for water constitutes as much the life as the beauty of the landscape; and it is true, both in a spiritual and in an earthly sense, that the world lives because heaven weeps over it." So far the picture is most attractive, but let man, in his thirst for gain, touch it, and see what it becomes—the common sewer, the filthy drain of the great city. In its infancy and purity, the rivulet swelling into the river brings nothing but loveliness and blessings, to be turned, as it leaves us, into a fruitful source of suffering, disease, and death. But it is ever thus. The willing servant becomes the selfish tyrant's slave. Water is of necessity forced to find its lowest level, and, as it passes on its downward course, it is seized upon by the man it

has just served, to carry hence the filth which pollutes it, and the germs of disease, which are thus readily spread through the communities among whom it flows to its home in the great sea. At times, when we are threatened by a visitation of some pestilence, we are stirred with apprehension, and, awaking to our danger, cry out for a remedy. Royal Commissioners enquire and report, the evil is acknowledged, and remedies are suggested; but still the pollution of our water supply goes on, and a prime necessary of life is rendered unfit alike for man and beast.

Is it not strange that, in these times of political excitement, when men are energized by the merest fads, the greatest domestic question of the age should cause so little stir. Man in his ignorance and selfishness abuses that which God has given in purity and abundance, in order that all may be able to drink freely without money and without price. When it is no longer fit for its purpose and his needs, his neighbour seizes and re-issues to him, purified it may be by some cunningly-devised system of filtration, that which was his birthright, but for which he must now pay; and so the circle widens till at the present moment our large towns have to procure their water supply from great distances and at enormous cost. No doubt the Water Companies are paying concerns, and in the main serve those who can pay satisfactorily. But visit the slums of our great cities, and look at the state of the poor who cannot so pay, and you will be able to realise what serious consequences result from an inadequate supply of reasonably pure water for drinking, to say nothing of other needful purposes.

Thanks to the liberality and Christian charity of some among us, drinking fountains for man and beast are to be seen in yearly increasing numbers along our great thoroughfares, and in places where the people are apt to congregate; but this is not enough; every street and alley, as well as every inhabited house, should have a continuous water supply as one of the necessary requisites to be provided by the owner, and his power to recover rent should be made conditional on the efficiency and sufficiency of this supply. Add to this an efficient water conservancy, with powers adequate to prevent the pollution of our rivers, and to enforce an effective scavenging, and suitable disposal of all sewage and other filth now permitted to drain into our water-courses, or foul our village wells, and there need be no fear of a water famine in this country, even with a further great increase of population.

Having thus briefly reviewed the surroundings, let us glance at the interior of a healthy home. The first point for consideration is space, and this must be regarded with reference chiefly

to the numbers to be accommodated, the arrangements for ventilating, lighting, and heating each separate apartment, and the subsidiary but essential domestic and sanitary appliances necessary for health and comfort. I cannot do better than refer you for detailed information on this subject to the admirable lecture on "Ventilation and Measurement of Cubic Space," by Sir Douglas Galton, published in Vol. XII. of the Transactions of The Sanitary Institute. The points in that lecture which I desire to emphasize are: the cubic space per individual, and the provisions for changing the air in that space by a continuous and adequate supply from without.

The term "*cubic foot*" as a unit of space has often led to misapprehension, and occasionally to grave errors in calculating the number of individuals who can be conveniently and safely accommodated in a given building. Take for example an apartment ten feet square and ten feet high, and you have a cube of ten feet containing one thousand cubic feet of air. Such an apartment would suffice for a single individual so far as space is concerned; but suppose the apartment was ten feet long by four feet wide and twenty-five feet high, you would have precisely the same number of cubic feet of air, but how different the nature of the accommodation. In the cube of ten feet a man would live and breathe comfortably for say an hour, in the other space, containing the same number of cubic feet, he would feel the suffocating effects of the impure air in a very few minutes. The differences in the two cases depend upon the slowness with which the lower stratum of air, saturated with carbonic acid gas and other products of respiration, diffuses itself through the higher column, as contrasted with the cube of ten feet. A practical illustration of this occurred to me shortly after the mutiny in India, when, in allotting accommodation for my corps in new quarters, a building containing 35,000 cubic feet of space was handed over as a quarter for thirty-five men. A glance at the room satisfied me that the floor space did not afford accommodation for so many without excessive crowding, and on expressing my doubts the General commanding, directed the Quartermaster-General to show how the cots for thirty-five men could be placed; but on making the attempt he was unable to find space for more than twenty-five.

It is, of course, an advantage to have, in every inhabited apartment, an air space above the cube in which the occupants of the room move and breathe; but this must be regarded in the light of a reserve, and must not be secured at the expense of the floor space, which is still more essential. The principle involved is of great importance in estimating the numbers to be

allotted to bedrooms, and dormitories in public schools, and other buildings where numbers are accommodated in each apartment. If it be made a *sine quâ non* that every individual is to have a separate bed, and every bed is to stand in the centre of a cube, the contents of which shall not be less than a given number of cubic feet—say 1,000,—and if such a room be ventilated so as to change the air in the whole compartment at least once in the hour, all that can be regarded as essential will have been secured.

In dealing with the ventilation of all apartments, and especially with day-rooms and dormitories, care must be taken so to arrange the inlets for fresh, and exits for foul air, that so-called draughts are not produced. This is not difficult in well-proportioned rooms; but in many instances draughts, of which complaints are made, are attributable to other causes than the ingress of fresh air. The chief of these, and the only one of any importance, is the extent of outer wall space filled with glass. In summer, when a common temperature obtains on both sides of the glass, these draughts are not felt, but in winter when the external air is at a low temperature, while the room is heated to a temperature many degrees higher, the escape of heat through the glass causes the air in contact with it to become heavier, and thus to sink to the floor, thereby creating a current in the air of the room, which is kept up by the fire or other source of heat. This current, moving from the window along the floor of the room, to replace the warmer air which rises when heated, is often so strong as to cause discomfort to invalids, and even to persons in health, who, not knowing the true reason, order every inlet for fresh air to be closed to their own eventual injury. A curtain or blind drawn over the glass is an effectual check to such a draught; but in the day time when light is needed this is not practicable, and the only radical cure for such draughts is the ventilation of the room by fresh air warmed before admission.

These draughts are more common in churches than perhaps anywhere else, and are as often caused by cold or damp walls as by the glass windows. The remedy in this case is obvious, though it is too much neglected. All such buildings should be kept dry, and warmed so as to heat the wall surface to the ordinary temperature which it is desired to keep up. If this is done by passing a sufficient current of dry and warm fresh air through the building, the congregation will find the air pure, and the place free from draughts; but if, as is sometimes the case, the stagnant air which has been shut up in the building since it was last used, is merely warmed by hot-water pipes passing through it, the atmosphere of the place will be both close and soporific.

In the absence of proper ventilation such rooms as are occupied, and necessarily warmed, require a constant supply of air from without, or if not so supplied, from the halls and passages within, to replace the air consumed by the fire; and this finds access through chinks round doors and windows, and even through the walls and ceilings. The sources of supply once detected, are apt to be regarded as offenders by persons susceptible of cold, and not unfrequently the consequences are troublesome. An old gentleman of my acquaintance, who was a sufferer from rheumatic gout, so dreaded all such draughts that he surrounded his easy chair with a screen, and closed as completely as he could every aperture through which air could gain access to his room. The fire naturally resented this, and, reversing the order of things, drew its supply down the chimney, and as a consequence blew the smoke in gusts into the room. The sweep was sent for, with partial relief. A cowl was tried, and proved a failure. Eventually an architect was consulted, who, recognising the cause, but knowing the peculiar views of my friend on the subject of ventilation, did not care to explain. Finding the room unoccupied he slipped behind a curtain and knocked a pane of glass out of the window. The effect was of course all that could be desired, till unfortunately the broken pane was discovered and repaired, when of course matters were restored to their original condition, and the chimney smoked as before. The practical lesson to be deduced from all this is to have no more glass in a room than is necessary for the free admission of the requisite light, and so to arrange for ventilation that the whole air in the room will be periodically replaced by fresh air from without, draughts being obviated in so far as the windows are at fault, by an arrangement of curtains or judiciously placed screens. In very cold climates it is not unusual to make the windows double, and this is occasionally done, even in England, in rooms in which an equable temperature is desired; but, as already suggested, all ordinary needs may be adequately provided for by a judicious arrangement of inlets, and properly adjusted blinds and curtains. The fact that draughts, often attended with much discomfort, can be so produced, should, however, receive more attention from architects than it does. It is only necessary to glance at the so-called villa residences, erected for the artizan and labouring classes, in the suburbs of our large towns, to see the undue proportion of glass which forms a part of the outer walls of those often very flimsy structures. A bow window is no doubt a desirable addition to a room of limited proportions, and in the summer it is much appreciated on account of the increased view thus secured; but in winter it is often a cause of much discomfort,

even when well constructed and furnished with shutters, which is not always the case in such cottages.

When such rooms are lighted with gas, the need for an ample supply of fresh air, and for the free escape of all products of combustion, is still greater. But this is a sanitary requisite which is not confined to the cottager. In many very good houses of the middle and upper classes it is a common grievance, and a source of danger to health not guarded against in the original construction of the house, and is therefore submitted to, rather than incur the expense necessary to remedy the evil. Fortunately, there is a near prospect of relief, for those who can afford it, in the electric light, but this will have to undergo further developments before it can be made generally applicable to domestic purposes at a reasonable cost. Meantime we have only the alternative of candles, or oil lamps, which some people regard as an effectual remedy. This is not so, however, except in so far as the lessened volume of combustion, with which those who use candles or lamps are satisfied, lessens to a corresponding extent the fouling of the air in the room. Free ventilation, and the removal of products of combustion, are as necessary in this case as when gas is used.

There are other points in domestic arrangements regarding which a few words may not be out of place here. The housing of the middle and lower classes in large towns has been in the past, and still is largely in the hands of speculative builders, who hope for a profitable return of capital so invested. Of such buildings it may be said, without attributing any improper motive to the builder, the cheapness of material, economy in their use, and on the class and quality of the labour expended on their construction, are ever present elements in the builder's estimate of cost. It is presumably to such considerations that leaking roofs, walls pervious alike to air and moisture, ill-fitting doors and windows, and badly jointed floors, are not uncommon defects in town houses rented at sums ranging from £100 to £20 annually. These defects must be remedied by the tenant as best he can, hence his resort to carpeting, curtains, wall papers, &c. These appliances have come down to us middle class people as luxuries, the more wealthy classes above us having wisely substituted impervious painted surfaces for paper, and solidly constructed, air-tight, and polished floors, for gaping boards covered with felt and carpeting. No doubt in the best houses, costly carpets, and rugs of elegant patterns and exquisite workmanship are still to be found strewn about the rooms, chiefly on the lines of traffic; but they are usually limited to such localities, the object being to deaden sound rather than to secure warmth and comfort, and they are in every case easily

removed for the purpose of dusting. From a sanitary point of view carpets as at present used are a questionable advantage, and the farther down the social scale their use extends, the less desirable they become. A limited experience of "spring cleanings" should suffice to make this obvious; but if we must have carpets, let them be limited in extent and so laid as to admit of their easy and frequent removal for dusting. A similar principle should regulate our use of curtains, lest they too become the happy hunting ground of the hostile microbe. Of furniture in general it may be said the safest limit is the utilitarian one. Ornamental additions in public day rooms may be tolerated, but in bedrooms the more Spartan the taste the better.

The man-made town is so irremediably defective in a hygienic sense that we turn from it to the country with a feeling of relief, and in the hope that here at least the members of those nomadic races, whom we claim as ancestors, may have left us more perfect specimens of what an English home ought to be. In this hope we are not disappointed. In many instances, no doubt, English country houses have been found wanting in some important sanitary particulars, attributable to the increasing luxuriousness of the age, and to the introduction of modern sanitary appliances into old buildings not originally designed for their reception; but in the more modern structures such oversights have been fairly remedied; and till the time comes when every mansion will include a sanitary pavilion, in which will be found all that is needful or desirable in this direction, we may rest satisfied if the drainage is reasonably effective.

With regard to the farmstead and the labourer's cottage, however, there is much need for improvement, mainly in their surroundings, and in the accommodation for the necessary farm stock and domestic animals. The rapid strides which have been made in the cultivation of sanitary science during the last half century, give good promise that within a comparatively short period the housing of farm stock and domestic animals of every class will be provided for on sound sanitary principles. That this is not yet realized is but too obvious, but the commercial interests involved will soon force forward the needful improvements.

At present the tendencies of all classes, who have to work for their living, seem to be to move into the towns, where higher incomes and social advantages are within reach; and it is only when repeated disappointments, terminating but too often in ruin and the poor-house, have opened their eyes, that the agricultural labourer and others so attracted recognize the mistake they have made. The causes of this are well

known, but the remedies are not so clear. A movement in the right direction has been recently made by Parliament in the Public Health and Allotments Acts, but the remedy is doomed to failure in so far as the allotments provided are not within easy reach of the cottager. What is really required is a plot of ground round every agricultural labourer's and artizan's cottage, sufficient to enable him to utilize profitably his idle hours and broken time, in the cultivation of garden produce for the use of his family. Such an arrangement would be a real boon, and would enable him to provide suitable accommodation for his pig, his hens, and his pigeons; turning to useful account kitchen refuse, and finding a convenient soil in which to bury all decaying organic matters and all so-called filth, to the relief and comfort of the cottagers, whose health will be thus protected, and to the enrichment of the garden soil, where all such matters can be turned to profitable purpose. Here too can be erected without cost the "Gehenna" for the cremation of all organic tissues, house dust, and other refuse, the sure harbingers of ever-present dangers to health; and the earth closet from which waste products can be at once passed to the soil.

But when will these changes come? Not till our great landed proprietors see the folly of letting land only under conditions which make agricultural pursuits unremunerative. "General" Booth's scheme for the regeneration and salvation of the "submerged tenth" has this one great advantage over most other efforts of this class, in that he attempts to replace the unemployed on the soil under conditions which promise the honest and industrious cultivator health, food, and clothing, with a reasonable prospect of a useful life. But why not begin at the other end of the problem, and deal with the agricultural labourer before he leaves the land, to become a town loafer suitable only for Salvation Army purposes? The city refuges with their workshop accompaniments, and farm colonies at home and abroad, are costly curative measures, intended no doubt to relieve suffering and thus to meet a pressing need. One hundred thousand pounds for their establishment, and thirty thousand a year for their working, but how much for the prevention of the evils which they are supposed to cure? These measures contemplate the redemption of poor Hodge and others who have wandered from their cottage homes in the country, and tumbled into a slum in the city, where, having lost money, hope, and character, they pass through the "*public*" to the prison, at the door of which they are fished out of the mire, and received into the refuge, where their regeneration begins, and from whence they may eventually hope to regain a cottage on some farm, possibly their own. All honour to the philan-

thropist who contemplates such a redemption, and works earnestly for its realization. But surely this is swimming in a circle which had better be broken! In such a case prevention would obviously be better than cure, and cheaper also, inasmuch as the cure must be problematical only, so long as agricultural pursuits do not pay. Better, as already suggested, begin at the other end of the problem, and try to keep the people on the land, rather than waste time and money in restoring them to it after social and financial shipwreck.

Some years ago I called attention to the pressing need for a land settlement, which would give to agriculture in this country the fair play it so much needs, to enable it to compete successfully with other food-producing countries, and thus cover these fair islands with a physically vigorous and contented population, which is after all the life of a nation. No doubt political economists say that this is impracticable, and that we must look to other regions having a better climate and a richer soil for our food products, securing an abundant supply by an open market. But is it true that a better land settlement would not enable the agriculturalist to compete successfully with the foreign food-producer in our own markets? As to quantity he may not be able to do so, but as to quality the question has yet to be solved. The physical qualities of both man and beast are more closely associated with the soil from which they draw their subsistence, and the climate in which they are reared, than many are disposed to admit. At all events the country is rapidly passing out of cultivation, and the people are flocking into the towns to swell still further the ranks of the unemployed. Mr. Palmer, an English tenant farmer residing near Towcester, evidently considers this state of affairs remediable; for in writing to me on this subject, and after enumerating the causes which were throwing land out of cultivation, the more important of which were the restrictive terms imposed by the landlord, and the rapidly increasing cost of labour, he adds: "Why do not the papers advocate such fiscal reforms, freedom of cultivation, and security of tenure, as would attract capital to the soil? Let it be made profitable to cultivate, and waste lands will soon be brought under cultivation, and the producing capacity of all other lands increased; this would mean work for hundreds of thousands of workmen now unemployed. It would further mean a great wealth of home-produced food for our nation." There is also a consideration of vast national importance lying behind this which ought not to be overlooked. Our highest naval and military authorities place in the front of all other reasons, for maintaining in overwhelming force our first line of defence, the fact that if our ports were closed, and

our food supply from abroad cut off, a few weeks would suffice to starve the nation into surrender. Surely this argument should induce the people not to neglect a cheap and effective means of augmenting their resources, by an increased home supply of food, while spending lavishly on the defences necessary to keep their ports open and coasts clear.

And now let me add a few words regarding personal hygiene. When all that is possible in the way of sanitary surroundings has been secured, there is still much which must devolve upon the individual who desires to enjoy to the full a vigorous, healthy existence. "Hygiene," says Parkes, "is the art of preserving health; that is, of obtaining the most perfect action of body and mind during as long a period as is consistent with the laws of life." Canon Knox-Little carries us a little farther by pointing out, on the authority of the Church and the Bible, "that the individual life is soul *and* body, and that we can only neglect either at our peril. Close and wonderful is the union between the two; terrible is the divorce at death; certain is the meeting again in eternity; and our Lord is emphatically called in Scripture 'the Saviour of the body.'" If this be true—and I, at least, do not doubt it—Christianity is only doing half its duty when it organizes missions for the salvation of men's souls, while it neglects the equally obvious duty of saving their bodies. Without following further at present the theological aspect of the question, it may be pertinent to recal the old Latin adage, *Mens sana in corpore sano*, as the true definition of the conditions to be realized. A recent writer of distinction has attempted to carry natural law into the spiritual world; may not the sanitarian with even greater propriety carry the moral law into the physical world? In other words, are we not fully justified in maintaining, that perfect health of body and mind require perfect purity of life and conduct, as well as of all the physical essentials which are, in a physiological sense, necessary to the well-being of the individual. In these days of scientific research men are apt to forget this, and while hunting for the physical cause, assumed to exist in every case, to overlook those conditions, the presence of which give direction and force to its action. A vigorous, healthy frame will resist the hostile microbe, or the pestilent malaria, which would prostrate at once the sickly debauchee, whose constitution had been weakened by self-indulgence.

The first essential towards the raising of a physically well-developed individual is a healthy parentage, but in this free country a man is free to marry regardless of the consequences such a step may entail on his children. If a man desires to serve the Queen in the Army, Navy, or Civil Service, a certifi-

cate of good health is a necessary qualification. If he wish to insure his life he must, in addition to such a certificate, produce evidence of freedom from hereditary predisposition to disease, but in the case of marriage there is no such restriction. The consequences are obvious. Indiscreet unions between individuals in many cases so unsound in health, and so shattered in constitution, that the children, if any, are doomed from their birth to a life of suffering more or less acute, and possibly also to a premature death, are common occurrences. The prevalence of consumption and other forms of so-called hereditary disease, both mental and physical, furnishes familiar illustrations of this in the experience of everyone. But putting aside all such instances, and assuming that the great mass of children born into the world are free from hereditary disease, how can the enormous mortality which occurs among children during the first years of their existence be accounted for? Doubtless much of this is attributable to ignorance, on the part of mothers, as to the best method of rearing children; not a little also to vicious habits and cruel neglect; but a still larger proportion of the young fall victims to so-called infantile diseases, which would I hold be comparatively harmless, but for the insanitary surroundings to which the great mass of the people, both in town and country, are unnecessarily exposed.

Some of these have been already pointed out. Others, such as unsuitable or insufficient food and clothing, are well understood, but of the aggregate I would only instance two. The first, and most easily remedied, is the growing neglect of mothers to nurse their own children. To this cause is largely attributable the mortality among infants under one year; while injudicious feeding must be regarded as an ever-present factor in the imperfect development and premature decay of large numbers of the human race. Another point on which I wish to lay emphasis is, not so much the injudicious selection of articles suitable as food, as the impurity of the articles so selected. This is especially the case with milk, on which the young are so dependent. The penalties now inflicted for such adulterations have done much to check the practice, but the scale of prices at which milk can be purchased is conclusive evidence of the fact that, to the poor at least, the article sold must have been largely diluted. Were it always certain that the water used for this purpose is pure the consequences would be of less importance, but in too many instances this is not the case; and, in addition to the fraud perpetrated on the purchaser, the consumer is also the sufferer. The history of many outbreaks of enteric fever, which have been traced to infected milk, adulterated with water in which the germs of

this disease abounded, is conclusive proof of this. No doubt the law provides a remedy for this and other similar offences, but the machinery for enforcing it is defective.

When the food is good of its kind the methods of preparation are often faulty. Instruction in domestic economy, and in cooking, is now given in some schools and encouraged by several voluntary societies, but the want is greatly in excess of the supply, and, until cooking is generally taught in all girls' schools, we can hardly look for much improvement. There is at present much wasteful extravagance in the methods of collecting, storing, and preparing food for all classes, which would under a better system meet the cost involved in the training. The initial difficulty appears to be the disposal of the cooked food, were cooking classes to be organized on a large scale; but if the artizan and working classes were regularly supplied with suitable meals at prices within their reach, they would gladly resort to schools of cookery for all they require. Children at school might be similarly provided for, and the mothers, thus relieved of the trouble and waste of time in marketing and cooking, would be free to devote their energies to other pursuits. Possibly it may be said that this scheme, if followed to its logical conclusion, would break up the poor man's home, and leave him without those domestic comforts which add so largely to the joys of life. The scheme need not have any such consequences. All it need aim at is the profitable consumption of articles cooked at the schools of cookery. There are many instances in which young men and women have no convenient homes to which they can resort for their meals, when employed continuously in positions demanding all their time; to such, a restaurant, where cheap meals suitable to their needs could be readily procured, would be a great boon, while many married couples would find profitable employment if only the preparation of that midday meal could be provided for. In large manufacturing centres the scheme would, I have no doubt, work well and profitably, and the system once developed would soon become general, and meet a much-felt need. The morning and evening meals, consisting as they usually do of easily prepared articles of food, might still be enjoyed by the family at home, while the dinner of all might be obtained at the nearest school of cookery.

The London School Board have already done much to improve the training of the young, both intellectually and physically, but the most important advance which has yet been made in this direction seems to me to be the establishment of classes for teaching the girls cooking. Unfortunately the pupils may be withdrawn from school before they have arrived at an age

most suitable for such training, but any knowledge, however elementary, and any practice in cooking, however limited, must be useful to them in after life. Meantime let us hope that the present elementary classes for cooking will soon be supplemented by more advanced classes, organized and equipped for the fuller instruction and training of such girls as are suitable, and intend to make cooking their profession. South Kensington and other Schools of Cookery are doing excellent work in this direction, but they do not meet the needs of the great mass of middle-class people, who require, and are able to give liberal wages to, a good plain cook, but cannot afford to pay a high salary, and at the same time provide a servant to wait upon the cook.

There is another class of practical instruction for girls which the London School Board have introduced, and for which they deserve much credit. In my address to the Congress at Brighton, two years ago, I alluded to the pressing need for reform in the laundry system—or rather want of system—in this country. For this the School Board is now endeavouring to provide a remedy, not without a promising measure of success.

Ample provision should be made for the physical and intellectual training of the young of both sexes, and all classes; but as has been already hinted, the perfect man cannot be secured without that continuous moral and social training which has its highest expression in perfect self-control and self-respect.

I am aware that many consider these latter qualities lie outside the sphere of the sanitarian, but I do not agree with this view; the salvation of the whole man is the problem to be solved, and if his body is to be kept in health and vigour he must cultivate those qualities which enable him to exercise moral, as well as physical control over all those appetites and pursuits which hurt the body or impair the mind. The training of the young is not all that it should be even in these days of progress. The race is for pre-eminence in something, without much consideration as to the ultimate result. The range of culture offered to pupils at our schools, of whatever class or sex they may consist, is greatly in excess of what many—I might almost say any—children can master. As a result the mentally strong gain pre-eminence in mathematics or some other cult, the physically well-developed shine in the cricket field, and all the others are dragged along at the chariot wheels of these two classes. Too little care seems to be taken to sort and classify and to train according to capacity, taking care to nourish and foster the weaker faculties, whether these be mental or physical. No doubt much of this is due to competition, and till a system can be devised which is less open to objection the weaker must go to the wall. But the system

is a bad one, and on it must rest some of the responsibility for the failures in life out of which our criminals, loafers, lunatics and cripples are manufactured.

But why dwell upon such matters? Life is to many hardly a blessing, why save it? Physical development is a possession of which a man may be proud, and which he may turn to profitable account, but after all it is a drug in the market. As for the halt, the maimed and the blind, the sick, the poor and needy, these seem almost a necessary part of a high civilization, and must be endured. Possibly so, but look at the cost. A tenth part of the money now spent in voluntary and benevolent efforts to put right that which is admittedly wrong would, if judiciously expended in the enforcement of sanitary requirements, do more to lessen sickness and suffering, and to rescue from an untimely grave the bread-winners on whom the happiness and comfort of so many homes depend, than can be realized by all the agencies of rescue and regeneration put together.

It would also sweep from our midst those insanitary slums in which the most degraded of the community crowd together, offering a congenial soil in which contagious disease is fostered, and from which it spreads among the people.

The housing of the well-to-do working class is in a fair way of being satisfactorily provided for, but nothing has yet been done to provide suitable accommodation for the poorest class of the people not actually paupers. Many of them are infinitely worse off than the regular inmates of the workhouse; but some element of self-respect, or pride it may be, constrains them to endure hardship and privation, even to the verge of starvation, rather than take that last, and to them irretrievable, step of going to the workhouse. There is much need for active interference in favour of this class, and the best method of aiding them appears to be also the cheapest. House them in homes in which they will be provided with those prime necessaries, pure air, good water, light, and shelter, at rates which they can pay, while leaving a sufficient margin for food and clothing. The loafer should not be tolerated under any circumstances; his gregarious and filthy habits, and his hopeless laziness and moral degradation render his consignment to the workhouse a necessity. I do not include under this head the casual wanderer out of employ, for whom other arrangements should be made; or the blind and otherwise maimed, who make a profitable display of their misfortunes; the latter should of course be compulsorily consigned to asylums supported by the State. After all that can be done has been realized, benevolence will still have a wide field for its exercise.

LENGTH OF DAYS.

LECTURE TO THE WORKING CLASSES,

BY

PROF. W. H. CORFIELD, M.A., M.D.(Oxon).

ABSTRACT.

HIS WORSHIP THE MAYOR OF PORTSMOUTH, in introducing the lecturer, said he was exceedingly pleased to see so many of his fellow-townsmen in attendance. A few days since, in the name of the inhabitants of the borough, he extended a hearty welcome to the members of the Congress, and he ventured to say that they fully approved of his action in that matter.

The dissemination of knowledge concerning the public health was a noble work, and it had been suggested that in Portsmouth they might make arrangements for periodical lectures on hygiene. He would be most happy to join any number of gentlemen interested in the matter in an effort to establish such a scheme. The meetings might be held in the Grand Jury-room, and he felt confident that his successor also would permit it to be used for that purpose.

Prof. CORFIELD, at the outset of his address, remarked upon the importance of the Sanitary Congress, which, he said, was brought together with one object—the prolongation of human life by the study of the various means by which health might be preserved and diseases prevented.

Was there any reason why they should not prolong life indefinitely? Why, when a person had grown to perfection, and by the food he consumed continuously replaced the losses in his body brought about by the use of its various parts, should he not go on for ever? The answer to that question was not an easy one. The reason was this: together with the process called life, there was always going on a process of hardening of the tissues of the body. That process commenced at the beginning of life, and went on until the individual was perfect; until the hard parts of the body were as hard as they should be, and the soft parts were as soft as they should be. It did not

stop there, however, and as time went on, the tissues of the skin became less elastic, the great arteries became hard and stiff, so that they could not send the blood through the body as they had done before, the nerves got hard, and the sensations became impaired. Even supposing the individual contracted no disease, the process went on until the hardening of the tissues of the lungs became such that respiration was stopped, or the hardening of the arteries offered such resistance to the flow of blood that the circulation could no longer go on, and the man died a natural death.

Hygiene, which was an art as well as a science, had been practised from the earliest times. They might even in these days learn most important lessons from the works of scientists of past centuries, and especially from the works of the Roman engineers, whose aqueducts conveyed a supply of unpolluted water from springs and lakes into their great cities. Some of their drainage works existed to the present day, and carried out the functions for which they were intended at the time of construction.

Although, as a science, hygiene was a thing of yesterday, they had by its aid arrived at great results. They had found out the causes of several of the communicable diseases, and, having discovered the causes, it was obvious that their prospect of preventing them was very much increased.

In commenting upon a few of the most important diseases by which mankind had been afflicted, he described the terrible effects of the Oriental plague, or "black death," which killed one-third of the inhabitants of the old world in one single invasion in the fourteenth century, and, appearing in London in 1665, killed 685,000 inhabitants. There could be no doubt, he said, that that disease had entirely disappeared as places had become more cleanly.

Scurvy was a disease which used to play havoc in the navies and armies of Europe until Captain Cook discovered that it was due to the absence of fresh vegetables, and now it never occurred, except, perhaps, when an expedition went to the polar regions, and rum was served out to the men instead of limejuice.

Typhus, or jail-fever, was formerly a terrible scourge, but it would not spread where there was no overcrowding, and was now rapidly becoming a disease of the past.

As to cholera, there were very few places in this country where sufficient filth existed to cause it to flourish, and it was not blown about by hurricanes, &c., but taken from place to place by people. The only real danger of the spread of the disease in England was the contamination of the water-supply

at its source. The most fertile source of typhoid fever was where the drainage of a house ended in a cesspool, and the well from which the water-supply was drawn was only a few feet away, both being in gravel soil.

All the diseases he had mentioned were nothing as compared with small-pox, of the extent of which in past centuries they could form no conception. It was no longer prevalent, because they had protection against it in vaccination.

Scarlet fever was a disease of which they had heard much and were likely to hear more. At the present moment there were 3,300 cases in the beds of the Metropolitan Hospitals. Little was known about its causes, except that it was readily communicated from one to another, and that quite recently it was found that in some way or other it was connected with cattle. Milk could communicate it to the human system, and as a matter of precaution it was wise to insist that every drop of milk brought into a house should be boiled before it was consumed.

Diphtheria, which was akin to scarlet fever, and went with it, had unfortunately taken hold of large towns, including London, and was increasing rapidly. A great deal remained to be discovered respecting that disease also.

Measles and whooping cough were not at present officially classed under the head of dangerous infectious diseases, although the former killed more children than any other sickness, and whooping cough was almost as fatal. Measles and scarlet fever could only be summarily stopped by the closing of the schools, at which they were chiefly spread. They did not spread in the open air to anything like the extent they did in houses or schools.

Epidemic influenza caused great mortality, and damaged a great number of people for the rest of their lives; and in referring to it he suggested whether while they were abolishing the conditions under which certain infectious diseases might exist, they might not by that very means create a condition of things in which other virulent and fatal diseases might flourish. That was certainly an alarming suggestion, but if true they could not help it, and the only course open to them was to continue to fight every disease as it came under their attention.

Passing on to consumption, "the great endemic plague of our climate," he stated that, although it had been shown by Dr. Koch to be caused by a living organism, it was spread by living in damp houses, by overcrowding, and by pursuing occupations in which much dust was produced, and he insisted upon the great importance of cleanliness in the prevention of this as well as of other diseases. Cleanliness had been described as "next to

godliness," but although a friend of his, an athletic divine, had said that it was a "very bad second," he himself maintained that without cleanliness there could not be much godliness.

After a short account of the mischiefs produced by over-indulgence in food and drink, and neglect of bodily exercise, he gave it as his opinion that cleanliness in the widest sense of the term, and moderation in the indulgence of our appetites and a sufficient amount of bodily exercise and of mental work, were the most important factors in the prevention of disease and the prolongation of life.

The mean length of life had been much increased in this country in recent years. We thought nothing now of the old limit of threescore years and ten, as we had so many instances of men living far beyond that period and yet possessed of all their faculties. He had calculated that the mean length of life in London during the last fourteen years had increased from $34\frac{1}{4}$ to over $38\frac{1}{4}$ years, a very important increase for so short a period. He attributed this increase to improved sanitary conditions, and insisted on the importance of sanitary legislation being continually brought up to the point at which public opinion would support it.

LECTURE TO SANITARY OFFICERS.

INAUGURAL ADDRESS,

GIVEN AT

WORCESTER

On OCTOBER 1st, 1892,

BY

Sir DOUGLAS GALTON, K.C.B., D.C.L., LL.D., F.R.S.

The Course of Lectures, of which this is the first, has been arranged by the County Council with the object of affording to the Sanitary Inspectors of the County an opportunity for preparing themselves to pass an examination so as to qualify them to obtain a certificate of competency in their duties.

In consequence of my position as Chairman of the Sanitary Committee of the County Council, I have been requested to give the opening Lecture, and I have accepted this proposal, because I thought that I should thereby have the opportunity of placing before the Inspectors a succinct view of the responsibilities which attach to their position, and of the duties which they have to perform.

The laws which regulate the health of the community may be said to date from the accession of Queen Victoria.

It was only at the beginning of the Queen's reign that the registration of births and deaths came into operation, thus affording the necessary data for ascertaining the relative intensity of epidemic diseases, and furnishing a basis for a scientific examination of the causes of the diseases. In 1839 disease was as prevalent in the rural villages as it was in the most filthy and crowded districts and towns; and the Poor Law Commissioners were directed to enquire into and report upon the

condition of the labouring classes. Their report recorded in all parts of the country much prevalent disease and consequent death.

In towns the people were crowded in courts and alleys, and swarmed in cellars, which were neither ventilated nor drained. The dead were buried in overcrowded churches, chapels, and churchyards in the middle of towns. The rural districts were no better. Parochial administration operated to degrade the inhabitants of the labouring class and to check tendencies to improvements. The window tax operated in all houses to shut out sun and air, and to foster darkness, want of ventilation, and consequently dirt. Each house had its cesspit, but in poor districts fœcal matter was often allowed to accumulate for years to avoid the expense of emptying.

The provision of pure water and the disposal of water after it had been fouled had scarcely been thought about. The law, however, was not so much in fault. It defined a common nuisance as: "An offence against the public either by doing a thing which tends to the annoyance of all the King's subjects, or by neglecting to do a thing which the common good requires."

But the Commissioners reported that notwithstanding this full definition, and notwithstanding ample legal power through the operation of Courts Leet, almost every town in England found in a low sanitary condition, and every village marked as the abode of fever, presented an example of standing violations of the law and of the infliction of public and common as well as of private injuries; the tenements were overcrowded, the streets replete with injurious nuisances, the air rendered noisome by these and by the smoke from factory chimneys, and the streams of pure water were polluted.

In 1840—41 the first Vaccination law was passed, and in 1853 vaccination was made compulsory. Small-pox had destroyed 30,819 persons in England in 1838. The number who died in 1890 numbered only 15.

The General Board of Health, which has since been merged into the Local Government Board, was founded in 1848, and initiated the system which subsequent Acts of Parliament have supplemented, enabling towns and localities to borrow money from the Government for sanitary works. Further Acts were passed in 1858 and 1861 and in subsequent years, and all their provisions were embodied in the Public Health Act 1875. This was the commencement of one of the most important stages in

the sanitary progress of the nation, because it was the first effort made to deal with the health of the community as a whole.

The office of Inspector of Nuisances had existed for many years under the provisions of various Acts of Parliament. In 1872 the Local Government Board obtained power to issue orders for defining their duties more specifically, and the Act of 1875 summarised the functions and powers of the Sanitary Authorities and of their officers.

The Public Health Act of 1875 brought into one focus the various regulations which had been especially devised in previous years to be a safeguard mainly for urban populations. But in the rural districts the powers of that Act were more limited. Since 1875, however, additional Acts of Parliament have been passed, and increased powers have been conferred on all Sanitary Authorities both Urban and Rural. Amongst these, in addition to the Acts for the prevention of pollution of streams and rivers, I would refer to the following:

1st. Mr. Brown's Water Act 1878, which compels owners of house property in Rural districts to improve the water supply of their property, and to provide a water supply for all new houses and cottages. This Act is not sufficiently attended to in Rural districts.

2nd. The various Acts for improving the dwellings of the labouring classes, which have culminated in the Housing of the Working Classes Act 1890.

3rd. The Acts relating to the Adulteration of Food.

4th. The Acts governing the Notification of Infectious Disease, and especially those giving powers for compelling isolation of persons suffering from infectious disease, and the disinfection of clothing, bedding and rooms; and also those providing accommodation for persons temporarily turned out of their houses for purposes of disinfection.

The formation of County Councils all over the country produced a new departure; for the County Councils, through the appointment of their own Medical Officers of Health, have become a focus of Sanitation in each county, by means of which the Reports of the Medical Officers of Health of Sanitary Districts in the County are yearly collated and brought under review, and thus attention is drawn to any Sanitary shortcomings in the Sanitary districts within the County. Although

the County Council has only limited executive powers in the Local Sanitary Districts, yet, the County Medical Officer, if appointed with judgment, if he is cautious not to interfere unduly, and if he remains independent of private practice, will obtain by degrees a wide influence, and gradually more and more become an adviser of the District Medical Officers of Health as well as of the Sanitary Inspectors, and be consulted in important cases by the Local Sanitary Authorities.

As an instance of the use which Local Sanitary Authorities have already made of the County Medical Officer of Health, I may instance the Notification of Infectious Diseases. In Worcestershire, all the Sanitary districts except three have adopted the Act for Notification of Infectious Diseases, and a record of all cases of infectious disease which occur in these Sanitary districts is sent by the District Medical Officers to the County Medical Officer, weekly; and he tabulates them and issues tabular statement weekly to each District Medical Officer, so that they are all kept aware of the state of infectious disease over the whole county. The County Medical Officer has also been called in to confer with District Medical Officers on various special matters in which Sanitary improvements were wanted, such as cases of polluted water supply, absence of drainage, defective house accommodation for the poorer classes, &c., &c. In regard to these I may mention that it is made especially the duty of the County Council to interfere as to the improvement or removal of insanitary dwellings, or as to the pollution of water, if the Local Authority fails in its duty.

From the analysis made by the County Medical Officer of the annual reports of the District Medical Officers, and from his own reports to the Sanitary Committee of the County Council on enquiries specially made by him, it became apparent that the several districts varied considerably in the conditions of their sanitation. Moreover, these various reports showed to the Sanitary Committee of the County Council, that there was a great want of uniformity in the knowledge and qualifications of the Inspectors themselves, and upon inquiry from the Sanitary Authorities, the Council ascertained that there are no uniform arrangements in the districts for ascertaining that an Inspector on appointment is necessarily conversant with the duties he has to perform. It therefore appeared desirable that some general instruction on these subjects should be offered by The Sanitary Institute.

The Public Health Act for London, passed in 1891, contains a provision affecting Inspectors in the Metropolis which undoubtedly will, on the first opportunity, be made applicable

to the whole of the country. That Act enacts that all Inspectors in the Metropolis that are appointed after 1895, must possess a certificate of competency from some examining body authorised by the Local Government Board.

This provision, when extended to the whole country, will make it incumbent on all Sanitary Inspectors who desire to advance in their profession to obtain certificates of competency. The Sanitary Institute has been appointed by the Local Government Board, under this Act, an examining body to issue such certificates. And the Sanitary Institute has organised a system for the preliminary training of the Inspectors by means of lectures before the examination. The County Council is now offering to those of the Sanitary Inspectors of this County who desire it, the opportunity of obtaining a certificate of efficiency by means of these lectures and examinations. When that has been achieved, and certificates of competency have been obtained by all Sanitary Inspectors, the county will possess qualified Inspectors; and the public will reap great advantage from the employment of competent men, provided the Inspector is encouraged to make use of the knowledge he has acquired.

But there are certain disabilities which attach to the position of Sanitary Inspectors. Periodical house-to-house inspections are essential to the due performance of the duties of an Officer of Health or Inspector of Nuisances, in the neglected portions of his charge. And the duties which devolve on the Sanitary Inspectors, consequent on such inspection, may be of a nature to bring them not only into contact, but also into antagonism, with their employers; and influences are sometimes brought to bear upon them, which render it often a very unpleasant and ungracious duty to put in force the provisions of an Act which, although designed for the public benefit, may be opposed to the personal and private interests of the parishioners, many of whom may be members of the Vestry, Guardians of the Poor, or may sit on Local Boards of Health in the district. It thus follows that the support which the Inspectors have a right to expect from their superior officers, such as Local Surveyors and Medical Officers of Health, is sometimes grudgingly given or absolutely withheld in cases where influential members of the local authority are concerned. Consequently the preventive measures which it is so important to institute prior to the breaking out of epidemic disease, are often postponed till the disease itself has appeared; and the remedial measures are thus resorted to, when too late.

If the public is to have the full benefit from the education of

the Sanitary Inspectors, Sanitary Authorities must not allow consideration for individuals to weigh with them in making orders for the removal of sanitary evils. There is also this: If an Inspector incurs the labour and expense of studying for, and obtaining a certificate stating that he is qualified for his profession, he must expect reasonable remuneration for his work, and reasonable permanency in his situation.

The duties of the Inspectors of Nuisances (now more generally termed Sanitary Inspectors) have been defined by the Local Government Board briefly as follows:—

I. They are to obey the directions of the Sanitary Authority and of the Medical Officer of Health, and they are to attend the Meetings of the Sanitary Authority when required.

II. They are to inspect their Districts systematically, and keep themselves informed of the Sanitary condition of their District; and whenever they receive notice of the existence of a nuisance, or of a breach of bye-laws, or of regulations made by the Sanitary Authority, they are to inspect the locality and report thereon to the Sanitary Authority, as well as upon any noxious or offensive trades established in the District. They have to see that the provisions of the Common Lodging Houses Act are duly carried out. And under the Housing of the Working Classes' Act, they may be called upon to ascertain whether any dwelling-house is in a state so injurious to health as not to be fit for human habitation.

III. They are to report to the Sanitary Authority when the water supply for domestic purposes is either wasted, or polluted, or defective.

IV. They are to inspect slaughter-houses and all shops and markets for the sale of butcher's meat, poultry, fish, fruit, vegetables, corn, bread, flour, or milk; and they are to cause any such articles as may appear to be unfit for food, but which are intended for the food of man, to be dealt with by a Justice of the Peace, subject to the opinion of the Medical Officer of Health.

V. They are to take samples of food and drugs when necessary, and they are to take any further proceedings required under the Sale of Food and Drugs Act.

VI. They are to give immediate notice to the Medical

Officer of Health of the appearance of any contagious, or infectious, or epidemic disease. They are to take necessary measures under the direction of the Medical Officer of Health for preventing the spread of such diseases; and when it appears to them that the intervention of such Officer is necessary, in consequence of the existence of any nuisance injurious to health, or of any over-crowding, or otherwise, they are forthwith to inform the Medical Officer of Health thereof.

VII. They are to be competent to superintend the execution of works for the suppression of nuisances, ordered by the Sanitary Authority, and to see that they have been duly executed.

VIII. They are to keep a record of the sanitary condition of houses in respect of which action has had to be taken under the Public Health Act of 1875, as well as to keep such other systematic records as are required by the Sanitary Authority; and they are to report fully on all matters to the Medical Officer of Health.

You will see by this summary that the Sanitary Inspector is intended to be the eye and right hand of the Medical Officer of Health; and it is only by keeping himself fully informed of the sanitary state of every part of his District, that he can bring to the notice of the Medical Officer all matters injurious to health in the District.

When I have advocated the importance of Sanitary Inspectors possessing a certain amount of technical education, I have often been met with the remark, that all that a Sanitary Inspector requires is common sense. Now common sense is a rare but most useful quality to possess, and combined with experience, common sense will go far to make up for want of special knowledge; but the duties laid on the Sanitary Inspector are wide; and since he has to keep the Medical Officer informed of any shortcomings in sanitation which occur in his District, he must possess special knowledge of the points which he has to observe and upon which he has to report to his chief.

Let us consider for a moment what is the special knowledge which the proper performance of the duties of a Sanitary Inspector involves.

He requires a knowledge of the laws which control Sanitary Administration; he requires a knowledge of the principles which govern sanitation; and he must be conversant with the

methods which have been devised to give effect to those principles. Now this knowledge covers a very large field, and I purpose to explain briefly here what it implies.

I. In the first place, his general education must be such as to enable him to keep accurate records, and make reports, accompanied if necessary with sketches illustrating such reports.

II. He requires an accurate knowledge of the numerous Acts of Parliament which confer his duties upon him, as well as a knowledge of the model bye-laws of the Local Government Board.

III. He must have a knowledge of the conditions which affect the health of dwellings, and must be cognizant of the various questions connected therewith, such as :

(*a*) Overcrowding; and he must be able to measure and calculate the cubic and floor space in rooms.

(*b*) He must understand the principles of ventilation, and know simple methods for applying these principles to houses.

(*c*) He must have a general knowledge of the constructional conditions affecting warmth ; that is to say, both in respect of the generation and distribution of heat in the most favourable manner, as well as in respect of the methods of construction which prevent the loss of heat.

(*d*) He must understand construction as bearing upon light and window space ; and the proportion which window space should bear to floor space and cubic space.

(*e*) He should be conversant with the conditions which foster damp, and with methods for preventing damp and dry rot.

(*f*) He must have a knowledge of the general conditions required for good drainage ; he must be able to apply simple methods for testing drains.

(*g*) He must be able to advise upon the best forms for sanitary fittings and appliances, and understand how to test them effectually.

This knowledge involves a certain acquaintance with details of building construction, and a knowledge of what constitutes good plumbing.

IV. He must possess some knowledge of the physical characteristics of good drinking water, and of the various ways in which water may be polluted; either in consequence of the position of wells and streams in relation to nuisances, or by other sources of injury, either to the sources of supply of water, or from the retention of water in cisterns and in houses; and he must be acquainted with the means of preventing pollution of water.

V. He should understand the conditions to be observed in the construction and maintenance of dairies, cow-sheds, and slaughter-houses, so as to avoid sanitary dangers.

VI. He should be able to report upon noxious and offensive trades and manufactures, and whether the operations of the trade are carried on under due regulation.

VII. He should understand the best and most efficient method of scavenging, and be able to advise upon the storage and disposal of refuse.

VIII. He is also bound to know the general characteristics of good and bad food (such as meat, fish, milk, vegetables, &c.), as well as to understand the duties assigned to him under the Sale of Food and Drugs Act.

IX. He has, further, to possess a knowledge of the regulations affecting persons suffering from infectious diseases; he must be acquainted with the use and value of disinfectants, and he must be able to apply the various methods of disinfection suited to the circumstances of each case.

This brief statement of the various matters with which the Inspectors must be cognizant if they are to perform their duties efficiently, abundantly shows they must possess a certain amount of technical knowledge, and this is not to be obtained without special training; hence you will easily understand that something more than mere common sense is wanted. No doubt in many of these matters the Sanitary Inspector has at hand the advice and assistance of the Medical Officer of Health; but if he is to be an efficient help to that officer, and if his advice is to

be of value and to carry weight with the householder, he must himself possess a large amount of this technical knowledge, the heads of which I have enumerated.

For instance, in the matter of Sanitary Appliances, Sanitary Inspectors should know the reasons which have led to the adoption of the various appliances for sanitation, because you may sometimes, by advising remedies for one insanitary condition, introduce, through the want of such knowledge, fresh unforeseen causes of disease.

Thus, when some fifty or sixty years ago, the evils of cess-pits in towns were seen to be very great, the proposal was made to turn the privies into water closets, and to send this refuse away in the sewers; but although until then, the sewers had only been constructed in a manner suitable for removing rain water, and had been only allowed to be so used, no one thought at that time whether the actual condition of the sewers was such as to permit of their being efficient carriers of this sort of refuse, nor was any thought given to the probable evils from sewer gas; and many deaths resulted from this ignorance. Indeed I know more than one case where the water closet soil pipe was led into the rain water pipe, which was connected with a water cistern under the house, the contamination of which caused much disease and some deaths. You cannot make a new departure in sanitary progress without much consideration, for each step you make introduces fresh conditions; this of itself is an evidence that it is highly important that the Sanitary Inspector should have sufficient knowledge of the principles of sanitation to enable him to appreciate these new conditions.

At the present time, one of the most important functions of the Sanitary Inspector is with reference to infectious and contagious disease. The Public Health Act of 1875 authorises the Local Sanitary Authority to provide hospitals and places for disinfection of bedding, clothing, &c., as well as ambulance carriages for the conveyance of sick persons. Recent Acts of Parliament enable Sanitary Authorities to require the notification of infectious diseases, and to isolate patients suffering from such diseases, as well as to pay the lodging of persons who must vacate their houses during the disinfection of the house and premises where a case has occurred.

I will give you an instance of the efficiency of isolation, and how that efficiency can be marred by the neglect of necessary precautions. We had a very serious epidemic of small-pox in London, 1884-5. According to the usual course of past

epidemics of small-pox, it should have recurred between 1889 and 1891 or 1892: but every case of small-pox in London, which cannot be isolated effectually in its own dwelling, is removed by ambulance carriages and steamers to ships placed in the lower Thames, and up to the present time the epidemic tendency has been kept under. There occurred, however, not many months ago a sudden outbreak of some ten or twelve cases, which afford a striking instance of how failure to isolate a patient may easily lead to a spread of the disease. The cases were all traced to one man who had fallen ill soon after landing from a foreign ship. His illness had not been recognised at once, and he had remained in his lodgings for some days before his case was notified, and before his removal to the hospital ships. The other cases were all traced to have had communication with this man, or his surroundings, under circumstances which showed that if he had been removed at once, probably all the others would have escaped the disease. Another case of the efficiency of isolation is also remarkable. You all, no doubt, know that the people of Leicester are much opposed to vaccination, and that a considerable proportion of the population is not vaccinated. They have, however, managed to escape during a long series of years from the ravages of small-pox, whilst epidemics of small-pox have raged in many towns and country districts of England. They have obtained this immunity, by paying very careful attention to the general sanitation of their town, and especially by maintaining a very efficient isolation in all cases where the disease manifests itself. They have an isolation hospital, to which anyone attacked with small-pox is removed, unless adequate isolation can be afforded at home; and they isolate not only the patient, but the family who have been in contact with the patient, paying their wages, and keeping them isolated under supervision for a sufficient period, to ascertain that they do not develop small-pox. Moreover, they do recognise the advantages of vaccination, in that they insist on vaccinating all such persons and their attendants. Inasmuch, however, as vaccination and revaccination afford an almost complete immunity from small-pox, the majority in this country wisely prefer the absolute safeguard of universal vaccination, to the risk of small-pox, which Leicester incurs; but we may learn from the Leicester practice in regard to small-pox, how to treat other infectious diseases, and by taking steps to isolate immediately every case of infectious disease, arrive at almost stamping them out.

The Sanitary Authorities who adopt the Act for the notification of disease, do, however, only part of the work necessary for

the prevention of infectious disease, unless they also provide isolation hospitals.

You must also remember that one of the conditions necessary to make isolation effective is the careful, immediate disinfection of premises, furniture, and clothing. Now this is especially the duty of the Sanitary Inspector. He must, therefore, possess adequate knowledge of the various materials to be used in disinfection, and how to apply them; he must also be furnished with adequate appliances for disinfection. It cannot be too strongly urged that if the notification of infectious disease is to be really effective as an instrument for preventing the spread of disease, careful immediate isolation and disinfection is imperative. I regret to say that in Worcestershire, many Sanitary Districts, and especially Rural Sanitary Districts, have only very partially recognised the importance of providing either isolation hospitals or adequate disinfecting appliances.

There is another point on which, I think, I can usefully say a few words, that is, on the disposal of house refuse. This subject is indeed one of growing importance, for our population increases rapidly, and the refuse which has to be disposed of increases in proportion. This refuse consists of 1st, fœcal matter; 2nd, of house slops; and 3rd, ashes, kitchen waste, and other household refuse. In country districts, where houses are separate, the utilization of these matters is comparatively simple. They can generally be utilized without sanitary danger, in increasing the fertility of the garden and the field. But where houses are close together, as is the case in large villages and in towns, the difficulties are greater. You will hear in the course of these lectures what are the most effectual modes of disposing of these matters. I would only observe that the refuse, on sanitary grounds, ought never to be allowed to remain long in the house itself, nor ought it to be accumulated near the house, either in heaps where it contributes to pollute the air, or in pits where it may contribute to pollute the wells. The only safe plan is to place it in a metal receptacle and to have it removed to a distance, for purpose of utilization, every morning. In the final disposal of town refuse, it has sometimes been the custom to adopt very unsanitary proceedings. In the vicinity of many large towns this refuse has been sometimes used as the means of raising the level of the ground to afford a foundation for new houses. The continued rising of vapour from the ground makes this a most dangerous proceeding, and fevers and other diseases have been thereby occasioned in the dwellings built on such a foundation. This method of disposal is now fortunately comparatively rare.

The process of dust sorting by hand, which is still to some extent practised, is an insanitary occupation, and a large number of towns resort to destruction by fire as the simplest method of getting rid of it. Where refuse is burnt without smell the method is not insanitary, it saves trouble, and the refuse affords a fuel which may be utilized to assist in driving engines, to make electric light, or otherwise. Burning house refuse is, however, somewhat wasteful, and the insanitary part of dust sorting is obviated by the method of mechanical sorting invented by Messrs. Rosser and Russell. By this plan the refuse is discharged from the dust-cart into a sorting cylinder, by the aid of which, and of other ingenious appliances, the refuse is almost entirely sorted without being touched by hand, and the whole can be utilized; any usable articles are sold to assist various manufactures; some is sold as fuel and breeze, and the waste paper is passed through steam, by which it is disinfected, repulped, and made into rough cardboard or rough brown paper. This process is a further development of the principle of the utilization of waste, which is so important a feature of our civilization. We have long recognised that the application of sewage to land as a means of purifying it is absolutely essential, in order to enable us to dispose of the sewage of inland towns, villages, and districts, if our water supply is not to be injured; and this application of the principles of utilization to the refuse from the dust-cart, relieves us from a great difficulty which has hitherto governed the disposal of refuse.

This, however, is only one of the numerous inventions by which our Sanitary appliances are being daily altered and improved. Many of these improvements show us that what we have been accustomed to look upon as comparatively insignificant matters, are really of vast importance to the preservation of health.

But you will see from this summary that in order to deal intelligently with these apparently small matters, the Sanitary Inspector must possess a very considerable amount of technical knowledge, and each year these requirements are increasing. Now, although one of the chief functions of the Sanitary Inspector is to give attention to these apparently small causes in order to bring them to the notice of the Medical Officer of Health, and thus assist in preventing the spread of disease, you are all aware that if a house and its surroundings are to be kept in a healthy condition, it must be so kept by those who live in the house, that is to say, by the householder himself. But the householder is often careless about such matters; more

frequently, indeed, he is not aware of the evils which defective sanitation entails on himself and on his neighbours. The Sanitary Inspector is, however, or should be always at hand to point out the requirements of Sanitation to the householder when he is careless, and to teach him these requirements when he is ignorant of them. In carrying out the duty of explaining his shortcomings to the householder, something more than mere knowledge is required. If he is to spread the cause of Sanitation efficiently, he requires eminent tact.

There are two ways of approaching people under an Act of Parliament. One way is to threaten legal proceedings, and to order things to be done without explaining the object of the work required. That is a very injudicious way. It hinders rather than advances Sanitation. The other way is to use the position of a Sanitary Inspector as a means of teaching people and educating them in sanitary methods, so as to make them understand that they thereby diminish the causes which lead to preventable infectious disease. That is the true way to ensure proper attention to the subject. It is far better for people to do the work of sanitation willingly, and look upon the Sanitary Inspector as their friend, than to regard sanitation in a hostile spirit, and look on the Sanitary Inspector as a prying, intolerant autocrat, who would force upon them the principles of sanitation, whether or not they like and understand them.

I do not think that I can impress upon you too strongly that all our sanitary progress depends upon the recognition by the public that sanitation is desirable and necessary.

If you look into the Bible you will see that Moses included his sanitary precepts as a part of the religion of the people, and that he committed the duty of enforcing sanitary regulations to the care of the priests. We ought to take an example from that plan, and make sanitation distinctly a part of our elementary education; but meanwhile with us the Sanitary Inspector is the missionary upon whom devolves the duty of explaining to the people the importance of paying a close attention to sanitary details.

I look upon this duty, which lies upon the Sanitary Inspector, of educating the people in sanitation as a great and important mission, and I should like to impress upon all Sanitary Inspectors the importance of the educational position which they hold. They are continually in direct touch with the people, and they possess admirable opportunities ready to their hands for explaining to the people the importance of paying close attention

to sanitary details. Until the people themselves feel the importance of sanitation, very little real and substantial advance can be made by the nation.

Acts of Parliament may be necessary to assist sanitary progress and to enforce sanitary discipline, but laws can do little unless aided by the earnest, the strenuous co-operation of every individual member of the community. The Sanitary Inspector has it in his power, in the daily exercise of his duty, to explain, to teach, and to show practically to the artizan and to the labourer how, by care and attention to cleanliness in their persons, their food, their homes, and their surroundings, they can preserve their own health, and save their children and families from preventable sickness and death. Therefore, in conclusion, I would urge you to impress upon the minds of those under your charge the words of the poet, Goldsmith :—

> "How small of all that human hearts endure
> That part which laws or kings can cause or cure!
> Still to ourselves in every place consigned,
> Our own felicity we make or find."

EXAMINATIONS IN SANITARY KNOWLEDGE FOR LOCAL SURVEYORS AND INSPECTORS OF NUISANCES.

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THE great and increasing importance of the duties devolving upon Local Surveyors and Inspectors of Nuisances, in connection with the various Acts relating to Public Health, Drainage and Water Supply, the Sale of Food and Drugs, &c., led The Sanitary Institute of Great Britain in 1877 to establish Voluntary Examinations, to appoint a Board of Examiners, and to grant Certificates of Competency in Sanitary knowledge.

The Sanitary Institute, in which the older body was incorporated in 1888, is continuing this important work.

The Examinations are arranged in two grades, and are intended to enable Local Surveyors and Inspectors of Nuisances, or persons desirous of becoming such, or of obtaining the Certificate of the Institute, to prove their

competency on the subject of Examination. Many Boards and Corporations require Candidates, when making applications for appointments, to produce a certificate of this kind. A register of successful Candidates is kept at the Offices of the Institute, and a copy will be forwarded to Local Boards and Sanitary Authorities on application.

The Local Government Board have approved of The Sanitary Institute as a body, whose certificate, that a person has by Examination shown himself competent for the office of Sanitary Inspector, under the Public Health (London) Act, 1891, shall be sufficient for the purposes of the requirements in Section 108 (*d*) of that Act.

Up to December 31st, 1892, 76 Examinations had been held—30 for Local Surveyors, and 46 for Inspectors of Nuisances. 2041 Candidates had been examined, 216 as Local Surveyors, and 1825 as Inspectors of Nuisances; of these 1238 passed the Examinations and received Certificates, 98 as Local Surveyors, and 1140 as Inspectors.

In order to make the Examinations for Inspectors more accessible to persons residing in the country, the Council now hold periodical Examinations in various centres, in addition to the Examinations held in London, provided that at least 20 Candidates send in applications for Examination. These Examinations are carried out in the same way as the Examinations in London, and no distinction is made in the Certificates granted.

Each Examination occupies a portion of two days. On the first day the Examination of Surveyors occupies six hours—viz., usually from 11 a.m. till 2 p.m., and from 3 till 6 p.m., and consists of written papers only. Inspectors of Nuisances have three hours' written Examination on the first day—viz., usually from 11 a.m. to 2 p.m. On the second day the Examination for each class is *vivâ voce*, with one or more questions to be answered in writing, if deemed necessary.

REGULATIONS.

Every Candidate is required to furnish the Board of Examiners with satisfactory testimonials as to age and personal character, and to give two weeks' notice previous to presenting himself for Examination. He must be able to write legibly and spell correctly, and possess a fair knowledge of arithmetic, so that he may be able to prepare a report on any subject connected with his duties, creditable to himself and to the Authority employing him.

No one under 21 years of age is admitted to the Examinations.

The fees payable for the Examination are as follows:—

As Surveyors, £5. 5s. As Inspectors of Nuisances, £3. 3s.

But when the Examinations are held in Provincial Towns in or out of England, £1. 1s. extra will be charged to the Candidate in order to cover the expenses incurred in holding an Examination out of London. The fee for Examination must be paid to the Secretary; 10s. 6d. on making application, and the remainder at least one week before the day of Examination. On the receipt of the fee, a ticket will be forwarded admitting to the Examination.

A Certificate of Competency, signed by the Examiners, and bearing the Seal of the Institute, is granted to each successful Candidate.

Unsuccessful Candidates are allowed to present themselves at any other Examination within twelve months on payment of half fees.

Any person having passed the Examination and received the Certificate for Local Surveyor is, by virtue of having such Certificate, upon proposal and election as Member of the Institute, exempt from payment of the Entrance Fee, and will be called upon to pay only the reduced subscription of £1. 1s. annually.

Any person having passed the Examination and received the Certificate for Inspector of Nuisances is, by virtue of having such Certificate, upon proposal and election as Associate of the Institute, exempt from payment of the Entrance Fee, and will be called only to upon pay the reduced subscription of 10s. 6d. annually.

EXAMINATIONS ARRANGED FOR 1893.

For Surveyors—

London—Friday and Saturday, June 9th and 10th.

For Inspectors of Nuisances—

Worcester—	Friday and	Saturday,	January 27th and 28th.
London	,,	,,	April 14th and 15th.
King's Lynn	,,	,,	April 28th and 29th.
Exeter	,,	,,	May 26th and 27th.
Dublin	,,	,,	June 23rd and 24th.
Leeds	,,	,,	July 7th and 8th.
Cardiff	,,	,,	July 28th and 29th.
Newcastle-upon-Tyne		,,	November 10th and 11th.
London	,,	,,	December 1st and 2nd.
Manchester	,,	,,	December 15th and 16th.

The forms to be filled up before the Examination, by Candidates and by those persons recommending them, will be supplied on application to the Secretary.

SYLLABUS of SUBJECTS for EXAMINATION.

FOR LOCAL SURVEYORS.

(1.) Laws and Bye-Laws—A thorough knowledge of the Acts affecting Sanitary Authorities, so far as they relate to the duties of Local Surveyors; also, of the Model By-Laws issued by the Local Government Board.

(2.) Sewerage and Drainage—The Sanitary arrangements of houses, including internal drainage, the construction of water-closets, privies, and dry-closets, the removal and disposal of refuse; the Sanitary defects of Builder's and Plumber's work; the Sanitary principles of Sewerage and Drainage and their application in the preparation of schemes for, and in the construction of, Sewerage works; the flushing and ventilation of sewers, and the treatment and disposal of sewage.

(3.) Water Supply of Towns and Houses—The sources of water, methods of collecting, purification (filtration, softening, &c.), and distribution. The Sanitary principles of Water Supply, and their application in the preparation of schemes for, and in the construction of, Water-works; the various ways in which water is likely to become polluted, and the best means of ensuring its purity.

(4.) Structural—Regulation of Cellar Dwellings and Lodging Houses, and of Baths and Wash-houses; General principles of Ventilation and their practical application; the amount of air and space necessary for men and cattle; the means of supplying air, and of ensuring its purity.

(5.) Highways and Streets—The Sanitary principles which should be observed in the construction and cleansing of streets and roads.

Candidates will be required to make free-hand sketches.

FOR INSPECTORS OF NUISANCES.

Duties of Inspectors of Nuisances as defined by the order of the Local Government Board, March, 1891.	Syllabus of Subjects for Examination.
(1.) He shall perform, either under the special directions of the Sanitary Authority, or so far as authorized by the Sanitary Authority, under the directions of the Medical Officer of Health, or in cases where no such directions are required, without such directions, all the duties specially imposed upon an Inspector of Nuisances by the Public Health Act, 1875, or by any other Statute or Statutes, or by the Orders of the Local Government Board, so far as the same apply to his office.	The Provisions of the Acts and Model By-Laws relating to the duties of Inspectors of Nuisances.
(2.) He shall attend all meetings of the Sanitary Authority when so required. (3.) He shall by inspection of the District, both systematically at certain periods, and at intervals as occasion may require, keep himself informed in respect of the nuisances existing therein that require abatement. (4.) On receiving notice of the existence of any nuisances within the District, or of the breach of any by-laws or regulations made by the Sanitary Authority for the suppression of nuisances, he shall, as early as practicable, visit the spot, and inquire into such alleged nuisance or breach of by-laws or regulations. (5.) He shall report to the Sanitary Authority any noxious, or offensive businesses, trades, or manufactories established within the District, and the breach or non-observance of any by-laws or regulations made in respect of the same.	A knowledge of what constitutes a Nuisance. Methods of Inspection, of Dwellings, Cellar Dwellings, Dairies, Milk-shops, Markets, Slaughter-houses, Cow-sheds, Canal Boats and Nuisances especially connected with Trades and Manufactories.
(6.) He shall report to the Sanitary Authority any damage done to any works of water supply, or other works belonging to them, and also any case of wilful or negligent waste of water supplied by them, or any fouling by gas, filth, or otherwise, of water used for domestic purposes.	The Physical Characteristics of good Drinking Water—the various ways in which it may be polluted, by Damage to Supply Works or in Houses, and the means of preventing pollution—Methods of Water Supply.
(7.) He shall from time to time, and forthwith upon complaint, visit and inspect the shops and places kept or used for the preparation or sale of butchers' meat, poultry, fish, fruit, vegetables, corn, bread, flour, milk, or any other article to which the provisions of the Public Health Act, 1875, in this behalf shall apply, and examine any animal, carcase, meat, poultry, game, flesh, fish, fruit, vegetables, corn, bread, flour, milk, or any other article as aforesaid, which may be therein; and in case any such article appear to him to be intended for the food of man, and to be unfit for such food, he shall cause the same to be seized, and take such other proceedings as may be necessary in order to have the same dealt with by a Justice: Provided, that in any case of doubt arising under this clause, he shall report the matter to the Medical Officer of Health, with the view of obtaining his advice thereon.	The Characteristics of good and bad Food (such as Meat, Fish, Milk, Vegetables).
(8.) He shall, when and as directed by the Sanitary Authority, procure and submit samples of food, drink, or drugs suspected to be adulterated, to be analysed by the analyst appointed under "The Sale of Food and Drugs Act, 1875," and upon receiving a certificate stating that the articles of food, drink, or drugs are adulterated, cause a complaint to be made, and take the other proceedings prescribed by that Act.	The sale of Food and Drugs' Act.

(9.) He shall give immediate notice to the Medical Officer of Health of the occurrence within the district of any contagious, infectious, or epidemic disease; and whenever it appears to him that the intervention of such officer is necessary in consequence of the existence of any nuisance injurious to health, or of any overcrowding in a house, he shall forthwith inform the Medical Officer of Health thereof.	The Regulations affecting persons suffering or recovering from Infectious diseases, and some knowledge of such diseases—The principles of Ventilation, and simple methods of Ventilating Rooms—Measurement of Cubic Space.
(10.) He shall, subject to the directions of the Sanitary Authority, attend to the instructions of the Medical Officer of Health with respect to any measures which can be lawfully taken by an Inspector of Nuisances under the Public Health Act, 1875, or under any other Statute or Statutes, for preventing the spread of any contagious, infectious, or epidemic disease of a dangerous character.	Disinfectants and Methods of Disinfection.
(11.) He shall enter from day to day, in a book to be provided by the Sanitary Authority, particulars of his inspections and of the action taken by him in the execution of his duties. He shall also keep a book or books, to be provided by the Sanitary Authority, so arranged as to form, as far as possible, a continuous record of the sanitary condition of each of the premises in respect of which any action has been taken under the Public Health Act, 1875, or under any other Statute or Statutes, and shall keep any other systematic records that the Sanitary Authority may require. (12.) He shall at all reasonable times, when applied to by the Medical Officer of Health, produce to him his books, or any of them, and render to him such information as he may be able to furnish with respect to any matter to which the duties of Inspector of Nuisances relate.	A Knowledge of the General Duties of the Office, and Methods of keeping the necessary Books and Records. Writing and Spelling.
(13.) He shall, if directed by the Sanitary Authority to do so, superintend and see to the due execution of all works which may be undertaken under their direction for the suppression or removal of nuisances within the district.	The proper conditions of good Drainage—The advantages and disadvantages of various Sanitary Appliances for Houses—Inspection of Builder's and Plumber's work—Scavenging and the Disposal of Refuse.
(14.) He shall, if directed by the Sanitary Authority to do so, act as Officer of the said Authority as Local Authority under the Contagious Diseases (Animals) Act, 1886, and any Orders or Regulations made thereunder.	
(15.) In matters not specially provided for in this Order, he shall observe and execute all the lawful orders and directions of the Sanitary Authority, and the Orders of the Local Government Board which may be hereafter issued, applicable to his office.	

Particulars as to Local Boards requiring Candidates to hold Certificates.

For several years past it has been the practice of many Local Authorities to insert in their advertisements for Inspectors of Nuisances clauses similar to the following, or otherwise to definitely recognise the desirability of a Certificate :—

Extract from advertisements—

POPLAR DISTRICT.

" . . . Candidates must possess a knowledge of building construction, and if not already in possession of the Certificate of The Sanitary Institute, must obtain such Certificate within twelve months of appointment. . . . "

PADDINGTON PARISH.

" . . . Applicants must have passed a satisfactory examination and be in possession of Certificates from The Sanitary Institute. . . ."

Extract from Advertisements—*Continued.*

LIVERPOOL.

"... Candidates must hold the Certificate of The Sanitary Institute of Great Britain. . . ."

METROPOLITAN—29.

City of London, 1891.
Battersea, 1885–9–91–3.
Bethnal Green, 1889—90.
Camberwell, 1891—92.
Chelsea, 1893.
Fulham, 1890—90.
Greenwich, 1890—91—92.
Hackney, 1891—93.
Hammersmith, 1891-2-3.
Hampstead, 1891—92.
Kensington, 1891—92.
Lambeth, 1890.
Limehouse, 1890.
Marylebone, 1891.
Newington, 1891.
Paddington, 1884—89.
Poplar, 1890.
Rotherhithe, 1893.
St. George's, Hanover Square, 1891.
St. George's-in-the-East, 1892.
St. James's, Westminster, 1891.
St. Luke's, 1887—91—93.
St. Margaret, Westminster, 1892.
St. Mary, Islington—1892—93.
St. Olave's, 1889.
St. Pancras, 1885—87—90—92.
St. Saviour's, 1889.
Wandsworth (4), 1888—89—91—92.
Whitechapel, 1891.

PROVINCIAL—92.

Aberavon, 1893.
Alton, 1893.
Barnet, 1890.
Bath, 1890.
Battle, 1890.
Bedwellty, 1891—92.
Bexhill, 1892.
Birkenhead, 1891.
Birmingham, 1892.
Blackburn, 1892.
Blackpool, 1889.
Blean, 1890.
Bolton, 1893.
Bournemouth, 1891—92.
Bradfield, 1891.
Brierley Hill, 1890—91.
Bristol, 1884—86.
Bromley, Kent, 1891—91.
Cardiff, 1890—91.
Carlisle, 1890—93.
Carnarvon, 1891.
Chesterfield, 1892.
Chiswick, 1891.
Clay Lane, 1892.
Coventry, 1891.
Croydon, 1891.
Darwen, 1891.
Dewsbury, 1886—90.
Dorchester, 1892.
Eastbourne, 1889.
Ely, 1888.
Exeter, 1889.
Foleshill, 1891.
Hailsham, 1886—91.
Halifax, 1892.
Hanley, 1891—92.
Hartlepool, 1890.
Hastings, 1892.
Hebburn, 1892.
Idle, 1892.
Kingston - upon - Hull, 1884—90—90.
Leeds, 1889.
Liverpool, 1886—91.
Lytham, 1887—92.
Maidstone, 1889—89.
Manchester, 1890-91-92.
Margate, 1888—90.
Margram, 1893.
Midhurst, 1892.
Milton-by-Sittingbourne, 1887.
Nantyglo, 1891.
Nelson, 1892.
Newcastle-on-Tyne, 1891.
Newmarket, 1887—88—90—92.
Northampton, 1892.
Norwich, 1892.
Oswestry, 1887.
Plymouth, 1892.
Pontypool, 1892.
Pontypridd, 1890—92.
Poole, 1893.
Portsmouth, 1890.
Pottersbury, 1893.
Rhyl, 1890.
Risbridge, 1893.
Salford, 1891—92.
Scarborough, 1888.
Sheffield, 1890—91—93.
Southampton, 1890—91.
Staffordshire County Council, 1892.
Stockport, 1891—92.
Stockton, 1887-90-91.
Stretford, 1892.
Stroud, 1892.
Sunderland, 1885—92.
Swansea, 1893.
Tendring, 1891.
Thakeham, 1890—90—92.
Twickenham, 1887.
Wakefield, 1891.
Ware, 1891.
Watford, 1887.
West Bromwich, 1892.
West Ham, 1891—93.
Wigan, 1891.
Willesden, 1891.
Winslow, 1893.
Wimbledon, 1890.
Winslow, 1893.
Wood Green, 1892.
Worthing, 1890—91.
Yorkshire, W.R., 1891.

COLONIAL—1.

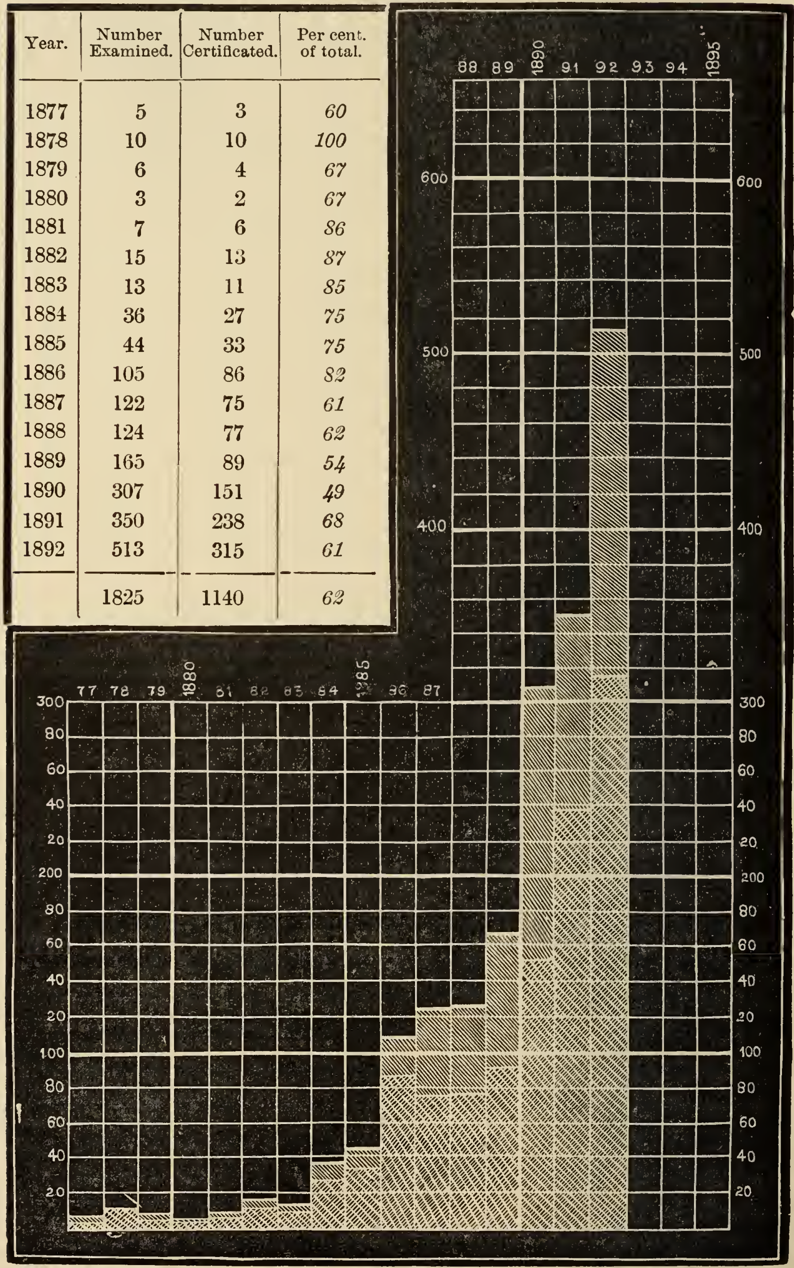
Cape Colony, 1891.

Table shewing the number of Candidates examined and certified each year.

Year.	Number Examined.			Certificated.				
				Number.			Per cent. of Total.	
	Surveyor	Inspector	Total.	Surveyor	Inspector	Total.	Surveyor.	Inspector.
1877	3	5	8	2	3	5	*67*	*60*
1878	11	10	21	3	10	13	*27*	*100*
1879	4	6	10	2	4	6	*50*	*67*
1880	10	3	13	6	2	8	*60*	*67*
1881	7	7	14	2	6	8	*29*	*86*
1882	6	15	21	3	13	16	*50*	*87*
1883	7	13	20	3	11	14	*43*	*85*
1884	14	36	50	7	27	34	*50*	*75*
1885	20	44	64	5	33	38	*25*	*75*
1886	19	105	124	9	86	95	*47*	*82*
1887	17	122	139	7	75	82	*41*	*61*
1888	25	124	149	8	77	85	*32*	*62*
1889	9	165	174	5	89	94	*56*	*54*
1890	18	307	325	8	151	159	*44*	*49*
1891	11	350	361	8	238	246	*73*	*68*
1892	35	513	548	20	315	335	*57*	*61*
	216	1825	2041	98	1140	1238	*45*	*62*

Table and Diagram shewing the number of Candidates examined and certified each year. Relating to Inspectors' Examination only.

Year.	Number Examined.	Number Certificated.	Per cent. of total.
1877	5	3	*60*
1878	10	10	*100*
1879	6	4	*67*
1880	3	2	*67*
1881	7	6	*86*
1882	15	13	*87*
1883	13	11	*85*
1884	36	27	*75*
1885	44	33	*75*
1886	105	86	*82*
1887	122	75	*61*
1888	124	77	*62*
1889	165	89	*54*
1890	307	151	*49*
1891	350	238	*68*
1892	513	315	*61*
	1825	1140	*62*



NOTE.—The total number of Candidates is shewn by the whole height of the column shaded, and the number who have obtained Certificates by the lighter portion.

LIST OF CANDIDATES WHO RECEIVED CERTIFICATES DURING 1892.

LOCAL SURVEYORS.

1892, June 18.	Brown, Edwin, Burgess Hill, Sussex.
1892, June 18.	Connal, Eben, 49, Kerrsland Terrace, Hillhead, Glasgow.
1892, July 9.	Daye, John, 3, Diana Street, Albany Road, Cardiff.
1892, June 18.	Dendy, William Cooper, Surveyors' Department, Lambeth.
1892, June 18.	Dixon, Frances Edward, Walton-le-Dale Local Board, Preston.
1892, Apr. 29.	Goddard, Joseph, Springfield Farm, Chinley, Chapel-en-le-Frith.
1892, Apr. 29.	Green, William Samuel, Idridgehay, Derby.
1892, June 18.	Griffiths, Harold, School Board Offices, Embankment, W.C.
1892, Apr. 29.	Kilford, Henry James, Borough Surveyor, Ilkeston.
1892, June 18.	Kirk, John Wright, Vestry Offices, Battersea Rise.
1882, June 18.	Lloyd, Christopher, 2, St. Mark's Terrace, New Brompton.
1892, June 18.	Miller, Henry, "The Wilderness," Carrow Hill, Norwich.
1892, June 18.	Mitchell, Lewis, Hurlford, Kilmarnock.
1892, June 18.	Newman, Reginald William, 53, Barnmead Road, Beckenham.
1892, Apr. 29.	Outram, Mason, Mill House, Dronfield, Sheffield.
1892, July 9.	Ridgway, Ernest Reginald, Long Eaton, Nottingham.
1892, June 18.	Stanbury, William Henry, Royal Engineers' Office, Freetown, Sierra Leone.
1892, July 9.	Williams, William Iltyd, Pentregwithel, Abergavenny.
1892, July 9.	Wilson, John A., 18, Rodney Terrace, Cheltenham.
1892, June 18.	Yates, Fred Spencer, assoc.m.inst.c.e., City Surveyor's Office, York.

INSPECTORS OF NUISANCES.

1892, June 11.	Ackernley, Joseph, Broughton Road, Skipton.
1892, Apr. 9.	Adams, Albert Edward, 29, Alexander Road, Northampton.
1892, July 16.	Allen, Thomas Holton, Strumpshaw, Norwich.
1892, June 11.	Anderson, George Hart, Town Hall, Middlesboro'.

1892, Dec. 3. ANDERSON, JASPER KIRTLEY, 13, Railway Street, Beverley, Yorkshire.
1892, June 11. ARMITAGE, FREDERICK L., Upper Spring Street, Huddersfield.
1892, June 11. ARMITAGE, THOMAS ALBERT, 12, South Parade, Huddersfield.
1892, June 11. ARNSBY, WILLIAM EDWARD, Long Acre, Bingham, Notts.
1892, Dec. 3. ASHLEY, SYDNEY, 14, Gower Street, W.C.
1892, Dec. 17. ASHURST, GEORGE NORMAN, 40, Allington Street, St. Michael's, Liverpool.
1892, Apr. 29. ATKINS, BENJAMIN, 31, Russell Street, Leamington Spa.
1892, Dec. 3. BACHE, ARTHUR EDWARD, 81, Elswick Rd., Lewisham.
1892, Dec. 3. BAGSHAW, ALLEN, Junr., 46, Beatrice Street, King Street, Plaistow.
1892, July 16. BAKER, HENRY KIRKHAM, 9, North Terrace, Cambridge.
1892, June 11. BALDWIN, PARKINSON, Farnhill, Kildwick.
1892, June 11. BARKER, WILLIAM THOMAS, Town Hall, Salford.
1892, Dec. 17. BARON, JOHN, 12, William Street, Little Lever.
1892, Dec. 3. BARTH, FREDERICK ALFRED, 17, Kensington Place, Campden Hill, W.
1892, Apr. 9. BATES, MATTHEW, Local Board Offices, Bromley, Kent.
1893, Dec. 3. BELCHER, CHARLES ROBERT, 84, Loughborough Road, S.W.
1892, Apr. 9. BENNETT, ALBERT, 138, Clarence Road, N.W.
1892. Dec. 3. BENNETT, HENRY MARLING, Victoria Street, Staple Hill, Bristol.
1892, Dec. 3. BILLING, GEORGE TIMOTHY, 16, Olinda Street, Portsmouth.
1892, Dec. 17. BLYTHE, OSBORNE, Junr., Foxton Hall, Alnmouth, Northumberland.
1892, June 11. BOLTON, JOSEPH, Sanitary Inspector, Otley.
1892, June 11. BORRAS, THOMAS, 5, Littlewoodhouse Street, Leeds.
1892, June 11. BOTTOMLEY, ALBERT EDWARD, 64, Ovenden Road, Halifax.
1892, Apr. 9. BOWDEN, WILLIAM GEORGE FREDERICK, 38, Crozier Street, Lambeth, S.E.
1892, June 11. BRAITHWAITE, THOMAS, Darton, Barnsley.
1892, Apr. 29. BRAMHAM, WILLIAM, Fern Cottage, Market Street, Clay Cross.
1892, Dec. 3. BRAYBON, FREDERICK WILLIAM, 52, Grosvenor Street, Brighton.
1892, Apr. 9. BROMLEY, JAMES, Rothwell Estate Office, Sharples Hall, Bolton.
1892, June 11. BROUGH, RICHARD, 28, Servia Grove, Leeds.
1892, Apr. 9. BROWN, REGINALD, Local Board, Ealing.
1892, Apr. 9. BROWN, ROBERT FREDERICK, 130, Devonshire Street, Mile End.

1892, Apr. 9. BROWN, ROBERT, Junr., 44, St. Ann's Hill, Wandsworth.
1892, June 11. BUCK, SAMUEL, Dacre Banks, Leeds.
1892, Dec. 3. BUCKTON, WALTER, 27, Ladbroke Square, W.
1892, Dec. 3. BUSBRIDGE, HAROLD, 96, Herbert Road, Plumstead.
1892, July 9. BUSH, SPENCER, High Roding, Dunmow, Essex.
1892, Apr. 9. BUTCHER, CHARLES ERNEST, 17, Circus Road, St. John's Wood, N.W.
1892, Dec. 3. BUTLER, CHARLES EDWARD, Surveyor's Office, Shoreham.
1892, Apr. 9. BUTTON, WALTER.
1892, July 16. CANNELL, CHARLES STEPHEN, 32, Knowsley Road, Magdalen Road, Norwich.
1892, Dec. 3. CARPENTER, ROBERT, Sergt.-Major, The Barracks, Hounslow.
1892, Mar. 5. CASELY, EDWIN JOHN, 46, Alpha Road, Southville, Bristol.
1892, June 25. CATTLIFF, WILLIAM, Town Hall, Newcastle-upon-Tyne.
1892, Dec. 3. CATTON, HERBERT, Sherfield House, Grays.
1892, Dec. 17. CHADWICK, JOHN, Petersfield, Hants.
1892, Apr. 9. CHALK, JOSEPH, Waterworks Engineer's Department, Southampton.
1892, July 16. CHALLENGER, WILLIAM, Southery, Downham Market.
1892, June 11. CHAMBERS, FREDERICK, Local Board Offices, Goole.
1892, July 16. CHAPMAN, CECIL ROBERT WILLIAM, 5, Carshalton Road, New Lakenham, Norwich.
1892, July 9. CHAPPLE, WILLIAM ROBERT, 50, Rodney Street, Swansea.
1892, Dec. 17. CHARLESWORTH, JAMES FREDERICK, 11, Union Street, Southport.
1892, July 9. CHARTERS, ROBERT H., The Moors, Cadoxton, Cardiff.
1892, Dec. 3. CHESTERFIELD, WILLIAM JAMES, 32, Rosaville Road, Fulham.
1892, June 11. CLARK, ARTHUR EDWARD, "The Sanatorium," York Road, Leeds.
1892, Dec. 3. CLARKE, CHARLES HENRY, 2, Rutland Terrace, High Road, Leyton.
1892, June 11. COATES, JOSEPH CARTER, New Brighton, Bramley, Leeds.
1892, June 11. COATES, WILLIAM MORFIN, 13, Northbrook Street, Chapeltown, Leeds.
1892, Apr. 9. COOK, WILLIAM GEORGE, Wetherell Cottage, Well Road, Hampstead.
1892, Dec. 17. CORRIGAN, JOSEPH, 24, Keble Street, Ince, Wigan.
1892, Mar. 5. COTTY, JOHN FREDERICK, 40, Princes Street, Bristol.
1892, Apr. 9. CROFTS, THOMAS JOHN, 50, Central Street, Landport, Portsmouth.
1892, Dec. 3. CUCKNEY, JAMES ALFRED, 37, Grosvenor Street, Brighton.

1892, Apr. 9. Currie, Thomas, Marshall Cottage, Hawkhill, Ayr.
1892, Dec. 3. Curtis, James, Court House, Marylebone.
1892, Apr. 29. Dane, Samuel, Primrose Lane, Glossop.
1892, Mar. 5. David, Philip, 23, North Luton Place, Cardiff.
1892, July 9. Davies, Dan, Ferndale, Rhondda Valley, Glamorgan.
1892, Dec. 3. Davies, Edward Plummer, Ty-Eos-y-Coed, Llanover, Abergavenny.
1893, July 9. Davies, Llewellyn, Priory House, Albany Road, Cardiff.
1892, Dec. 17. Davies, Samuel, 6, Edith Road, Anfield, Liverpool.
1892, July 9. Davies, Watkin J., 4, Queen Street, Maesteg.
1892, June 25. Davison, George William, Boys' Industrial School, Sunderland.
1892, Dec. 3. Dawes, Henry, 72, Rendlesham Road, Clapton.
1892, Mar. 5. Dawson, Edward Howard, A.R.I.B.A., 41, Market Street, Lancaster.
1892, Mar. 5. Daye, John, 3, Diana Street, Albany Road, Cardiff.
1892, Dec. 3. Dearsley, James H., 46, Glenarn Road, Lower Clapton.
1892, June 11. Denham, Hodgson, Aberford, Leeds.
1892, Apr. 29. Dewhirst, James, 4, New Bridge Street, Keighley, Yorkshire.
1892, Dec. 17. Dickinson, Arthur James, 456, Glossop Road, Sheffield.
1892, June 11. Dodgson, William, Woodside, Cononley, Keighley.
1892, Apr. 29. Dolman, William, 15, Arundel Street, Derby.
1892, July 16. Dowzard, Richard, 85, Esmond Street, Liverpool.
1892, Dec. 3. Drake, Frederick, 64, King Street, Maidstone.
1892, June 11. Dunhill, John William, 13, Berry Street, Hall Lane, Bradford, Yorks.
1892, Dec. 3. Edser, William, 15, Harrow Road, Dorking.
1892, June 25. Egglestone, William Morley.
1892, Apr. 9. Ellis, Stanley, 28, Chertsey Street, Guildford.
1892, Dec. 3. Elms, Thomas Hood, 43, Mall Road, Hammersmith.
1892, Mar. 5. Evans, John Isaac, 11, Blanche Street, Caeharris, Dowlais.
1892, Dec. 3. Farmer, William Richard, 133, Paulet Road, Camberwell.
1892, Dec. 17. Finch, John Thomas, 17, Cornwallis Street, Liverpool.
1892, July 9. Flood, William Holsgrove, 44, High Street, Crediton, Devon.
1892, Dec. 3. Fortune, Edward Isaac, 12, Frederick Street, Gray's Inn Road, W.C.
1892, Apr. 9. Foster, Edward Trump, 29, St. Maur Road, Fulham.
1892, Dec. 3. Freeman, Walter, 31, Lamb's Conduit Street, W.C.
1892, Dec. 3. French, Harry C., 113, Shirland Rd., Paddington.
1892, Apr. 9. Friend, Alick Edward, 22, Hemingford Road, Barnsbury.

1892, Dec. 17.	GAMBLE, DAVID, Local Board, Ashton-in-Makerfield.
1892, Apr. 9.	GARNHAM, ALBERT EDWARD, Beulah Place, Beulah Hill, Norwood.
1892, June 25.	GIBSON, JOHN, Town Hall, Newcastle-upon-Tyne.
1892, Apr. 9.	GOLDER, THOMAS COLLINGS, 5, Connaught Road, Folkestone.
1892, Dec. 3.	GOODALL, NORMAN, Russell Street, Batley.
1892, June 25.	GOODFELLOW, ROBERT HECTOR, Camp Street, Maryport.
1892, Dec. 3.	GRANT, ERNEST HENRY, Angmering, Worthing.
1892, Dec. 17.	GRAYSON, SAMUEL, 5, Trajan Street, South Shields.
1892, June 11.	GRIFFIN, THOMAS GULLIVER, Laurel Cottage, Clay Cross, Chesterfield.
1892, July 9.	GRIFFITHS, WILLIAM, 56, Upper Aberdyberthi Street, Swansea.
1892, June 11.	HAIGH, BENJAMIN, Town Hall, Huddersfield.
1892, June 25.	HALL, GEORGE WILLIAM, The Workhouse, Cheadle, Stoke-on-Trent.
1892, July 9.	HALL JOHN, Poundfield, Stonehouse, Gloucester.
1892, June 11.	HALL, THOMAS JOHN, Rural Sanitary Authority, Barnsley.
1892, June 11.	HAMMOND, WILLIAM HENRY, South Parade, Horbury.
1892, June 25.	HARDING, JOHN, Baker Street, Haswell, Sunderland.
1892, July 16.	HARDY, ALFRED, Yarmouth Road, Thorpe, Norwich.
1892, Dec. 17.	HARGREAVES, JAMES WILLIAM, 296, New Church Road, Stacksteads.
1892, July 9.	HARRISON, ROBERT COLCHESTER, Brynonen, Dowlais, Glamorgan.
1892, Apr. 9.	HART, FREDERICK, 32, Wyndham Street, Bryanston Square, W.
1892, Dec. 3.	HARVEY, WILLIAM, 117, Dunlace Road, Lower Clapton.
1892, Dec. 3.	HEATH, JAMES, 85, Dennett Road, West Croydon.
1892, Apr. 9.	HENLEY, AMOS S., Camberwell Workhouse, Willowbrook Road, Peckham.
1892, Dec. 3.	HERRIN, JOHN, 31, The Avenue, Acre Lane, Brixton.
1892, Apr. 9.	HERRIOTT, HARRY, St. George's, Hanover Square.
1892. Apr. 29.	HERROD, HERBERT, Barrow-on-Soar, Loughborough.
1892, July 9.	HILL, CHARLES WILLIAM, 30, Donald Street, Cardiff.
1892, Dec. 17.	HILL, SAMUEL GOSTAGE, 14, Aigburth Road, Grassendale, Liverpool.
1892, Dec. 3.	HILLYARD, HENRY, 74, Duncombe Road, Hornsey Rise.
1892, June 25.	HINDLE, WILLIAM JAMES, Morton, Bingley, Yorks.
1892, June 11.	HIRST, FRANK S., 53, Kingcross Road, Halifax.
1892, Dec. 17.	HITCHMOUGH, WILLIAM, 142, Tunhill Rd., Liverpool.
1892, Apr. 9.	HOBBS, JAMES SHOTTEN, 61, New Road, Buckland, Portsmouth.
1892, Dec. 17.	HOLDEN, TIMOTHY, 272, City Road, Manchester.
1892, June 11.	HOLDROYD, ALFRED, Local Board, Cleckheaton.

1892, Dec. 3. HOLLAND, EDWARD LOUIS COPEMAN, 118, St. James' Road, Portsmouth.
1892, June 11. HOLMES, JOHN EDWARD, North Collingham, Newark.
1892, June 11. HOLROYD, JAMES BATES, Poor House, Barkisland, Yorks.
1892, Apr. 29. HOPKINSON, FREDERICK, 11, Cross St., Chesterfield.
1892, Apr. 9. HORTON, WILLIAM, 22, Halsey Street, Chelsea.
1892, Dec. 3. HOSKINS, NANDY W., 61, Plumstead Common Road, S.E.
1892, June 11. HUDSON, ALBERT EDWARD, 28, Oxford Lane, Siddall, Halifax.
1892, Dec. 17. HUGHES, ROBERT JOHN, 105, Claughton Road, Birkenhead.
1892, Dec. 3. HUNTER, JOHN, Grove Road, Windsor.
1892, Dec. 17. HURST, JOHN, 158, Palmerston Street, Beswick, Manchester.
1892, Mar. 5. HUTCHINGS, WILLIAM ARTHUR, 15, St. John's Park Terrace, Winchester.
1892, Apr. 29. HYDE, GEORGE, 214, Osmaston Road, Derby.
1892, July 9. JAMES, WILLIAM ROBERT, Local Board Office, Abersychan, Pontypool.
1892, Dec. 3. JARRATT, EDWARD JOHN, 11, Albion Hill, Lewisham Road.
1892, June 25. JEMSON, WILLIAM, Hoskinshire, Out Rawcliffe, Garstang.
1892, Dec. 3. JENKIN, CHARLES HENRY, 30, Little Russell Street, Bloomsbury.
1892, Dec. 3. JEVONS, JOHN HENRY, Braintree, Essex.
1892, June 11. JONES, JOSEPH, 1, New Street, Pudsey.
1892, Apr. 9. KELF, CHARLES H., 22A, Dorinda Street, Liverpool Road, N.
1892, Dec. 3. KERSLAKE, CHARLES HENRY, 47, Relf Road, Peckham Rye.
1892, Apr. 9. KILLGALLIN, CHARLES J., Court House, St. Marylebone, W.
1892, Apr. 9. KNOX, CHARLES GEARY, 60, Lordship Road, Stoke Newington.
1892. Apr, 9. LAMPORT, Miss ETHEL FRANCES, 55, Burton Crescent, W.C.
1892, Dec. 3. LAWRENCE JAMES, 12, Bridge Road West, Old Battersea, S.W.
1892, Apr. 9. LAWRENCE, WILLIAM JAMES, 71, Chadwick Road, Peckham.
1892, Dec. 3. LEACH, ROBERT, 6, Barton Street, Westminster.
1892, Apr. 29. LEE, JOHN, 64, St. Paul's Road East, Birkenhead.
1892, Dec. 17. LEE, ROGER, 10, Thompson Street, Hendon, Sunderland.
1892, Dec. 3. LEWIS, ELI, Pendoylan, Cowbridge, South Wales.
1892, June 11. LIGHTFOOT, JAMES, Town Hall, Huddersfield.
1892, June 11. LINDLEY, JOSEPH, Cliffe Villa, Staincliffe, Dewsbury.

1892, July 16. Ling, Alfred George, Hempstead, Holt, Norfolk.
1892, Dec, 3. Lintott, John, 80, London Road, Brighton.
1892, Apr. 29. Little, William, 26, Overbury Street, Liverpool.
1892, Apr. 9. Loasby, Fred Walter, 30, Liverpool Street, King's Cross.
1892, Dec. 17. Lord, Ralph, 38, Alexandra Road, Ashton-under-Lyne.
1892, Dec. 3. Lovelock, Herbert John, 5, St. Edward's Terrace, Stamshaw, Portsmouth.
1892, Dec. 3. Lyon, Frederick, 616, Mile End Road, E.
1892, Apr. 9. Lyon, James Joseph, 6, Rice Lane, Walton, Liverpool.
1892, Mar. 5. Lyons, John Thomas, Eastwood Villa, Wentworth, Road, Bishopston, Bristol.
1892, Dec. 3. Madge, Frank Wm., 46, London Road, Forest Hill.
1892, June 11. Mallinson, Thomas, 95, Gowthorpe Street, Selby.
1892, Dec. 3. Marks, Charles Alfred, 7, Somerset Terrace, Merton Road, Wandsworth.
1892, Dec. 3. Marrable, Horace, 16, Willenhall Road, Plumstead.
1892, Apr. 9. Martin, A. W., 3, Plumstead Road, Plumstead.
1892, Apr. 9. Martin, Henry Richard, Essendine Road, Caterham.
1892, June 11. Massey, William, Marine Hotel, Whitby.
1892, June 11. McMillan, John, 26, Park Street, Stockport.
1892, June 25. Meadows, John William, 52, Camden Street, North Shields.
1892, July 9. Meazey, Thomas, Grove Cottage, Stanwell Road, Penarth.
1892, Dec. 3. Millard, Charles K., m.b., Costock, Loughborough.
1892, Apr. 9. Miller, Frederick William, 137, Salcott Road, Clapham Common.
1892, Apr. 9. Miller, William J., 53, Balliol Road, Buckland, Portsmouth.
1892, June 11. Millington, Thomas Charles, Craven Terrace, Settle, Yorks.
1892, June 11. Mills, John William, 21, Victoria Mount, Woodsley Road, Leeds.
1892, Apr. 9. Mills, Ernest Edward, 4, Rugby Place, Brighton.
1892, Dec. 17. Mooney, Patrick, 353, Chester Road, Manchester.
1892, Dec. 3. Morley, Frederick William, 19, Tadmore Street, Shepherd's Bush.
1892, Apr. 29. Morley, William, 7, Shaw Street, Edgbaston Road, Derby.
1892, Apr. 29. Morrison, John William, Town Hall, Salford.
1892, Dec. 3. Nankivell, Herbert Henry, Hoe, Nr. Dereham, Norfolk.
1892, June 25. Newby, John, 1, Newton Terrace, Hebburn New Town.
1892, Apr. 9. Newnham, Frank George, 9, York Place, Brighton.

1892, Apr. 9.	Northcombe, James Webb, 15, Greenbrook Terrace, Taunton.
1892, Dec. 3.	Norton, Elizabeth Jane, 8, Clifton Gardens, W.
1892, June 11.	Nowlin, Henry Clark, Health Office, Sheffield.
1892, Apr. 9.	Odell, Arthur, 22, Dorset Street, Pimlico.
1892, Apr. 9.	Orchardson, Robert, 2, Manor Place, Ospringe, Faversham, Kent.
1892, June 25.	Osborne, Walter, 13, Third Street, Gateshead-on-Tyne.
1892, July 9.	Owen, John Thomas, 9, Brynteg Terrace, Merthyr Tydfil.
1892, Dec. 17.	Palliser, William Arthur, 55, Canning Street, Birkenhead.
1892, Dec. 3.	Palmer, Herbert Albert, 315, Ivydale Road, Nunhead.
1892, Apr. 9.	Palmer, James, 35, King William Street, Greenwich.
1892, July 16.	Pank, R. Arnold, St. Andrew's, Norwich.
1892, June 25.	Parker, John Edward, Lanchester, Co. Durham.
1892, Dec. 3.	Parkinson, Arthur Charles, 27, Southampton Row, W.C.
1892, July 16.	Parrott, John Stephen, Downham Market, Norfolk.
1892, Dec. 3.	Patching, Walter C., 9, Chapel Road, Worthing.
1892, Dec. 3.	Patching, William George, Belfort, Worthing.
1892, June 11.	Pearson, Walter, 25, Milton Terrace, Hanson Lane, Halifax.
1892, Dec. 3.	Phillips, Charles, 68, Swinton Street, Gray's Inn Road, W.C.
1892, Apr. 9.	Pidwell, Engall Thomas, 13, Kelvin Grove, Sydenham.
1892, July 9.	Pile, George Charles, Woodbine Cottage, Devizes.
1892, Apr. 9.	Pilling, Edwin, 77, Tonge Moor Road, Bolton.
1892, Apr. 9.	Pope, Thomas Stephen, 66, Toronto Terrace, Brighton.
1892, Dec. 3.	Porter, John James, Halse Road, Brackley, Northampton.
1892, Dec. 17.	Price, John Henry, 29, Balmoral Road, Fairfield, Liverpool.
1892, Apr. 9.	Priest, Alfred, 64, Elswick Road, Lewisham.
1892, Dec. 17.	Puddle, Walter Louis, Health Office, North Church Street, Sheffield.
1892, June 25.	Purdie, Alexander, Lavery Street, Bill Quay, Northumberland.
1892, Dec. 3.	Purnell, Arthur Edward, 26, Solent Crescent, West Hampstead.
1892, Dec. 3.	Rance, John Walter, 15, Vandon Street, Westminster.
1892, Dec. 3.	Read, Walter Herbert, 8, Alpha Place, Regent's Park, N.W.
1892, Apr. 9.	Reading, George, 6, Windsor Terrace, Cottage Grove, Southsea.

1892, Dec. 17.	REID, THOMAS ALEXANDER, 81, High Street, Perth.
1892, Apr. 9.	RICHARDS, WILLIAM, 18, Nunhead Grove, Peckham Rye.
1892, Apr. 29.	RIDGWAY, ERNEST REGINALD, Long Heaton, Nottingham.
1892, Apr. 29.	RIDOUT, ALFRED RICHARD, Wirksworth, Derby.
1892, June 11.	RIDSDALE, JOHN WILLIAM, Municipal Buildings, Leeds.
1892, Dec. 17.	RITCHIE, PETER, 27, Jamaica Street, Edinburgh.
1892, Apr. 29.	ROBERTS, DAVID, Ashbourne, Derbyshire.
1892, Dec. 17.	ROBERTS, EVAN, 48, Bangor Street, Carnarvon.
1892, Apr. 9.	ROBERTS, WILLIAM HENRY, Brook Villa, Crossbrook Street, Waltham Cross.
1892, Apr. 9.	ROBINS, HAROLD GRAY, 29, West End Lane, N.W.
1892, June 11.	RODWELL, ASCOUGH, Union Offices, Skipton.
1892, Apr. 9.	ROPER, J. STANLEY, Greenway Court, Hollingbourn, Maidstone.
1892, July 16.	ROSHIER, EDWARD, 31, York Street, Norwich.
1892, June 11.	ROTHERA, FREDERICK, 71, Beech Road, Sowerby Bridge.
1892, Apr. 9.	ROW, EDMUND, 10, Granville Road, Hoe Street, Walthamstow.
1892, Apr. 9.	ROWLAND, SAMUEL, Local Board, Pontypridd.
1892, Mar. 5.	ROYLE, CHARLES, Wormgate, Boston, Lincolnshire.
1892, June 11.	RUMMING, HENRY, Health Office, Sheffield.
1892, Dec. 3.	RUSCOE, FRANK HARVEY, 6, Great Castle Street, W.
1892, Dec. 17.	RUSHTON, EGBERT, 9, Kendal Street, Blackburn.
1892, June 25.	SANDERSON, ISAAC, 11, Percy Street, Sunnybrow, Willington, Durham.
1892, Apr. 9.	SANDON, EDWARD H., 327, Harrow Road, W.
1892, Apr. 9.	SCOTT, GEORGE LATTIMORE, 91, Queen's Road, Landport, Portsmouth.
1892, Dec. 17.	SCOTT, MRS. SARAH, 56, Irlam Road, Bootle.
1892, Apr. 9.	SCUDAMORE, GEORGE WASHINGTON, 26, Constance Road, East Dulwich.
1892, Dec. 17.	SHARRATT, JAMES BRADLEY, Town Hall, Manchester.
1892, Dec. 17.	SHAWFIELD, ARTHUR, 47, St. Domingo Vale, Everton, Liverpool.
1892, Dec. 17.	SHELDON, WILLIAM, Town Hall, Workington.
1892, Apr. 9.	SHEPPARD, RICHARD JOHN, 49, Broke Road, Dalston.
1892, Apr. 9.	SHORTLE, RICHARD, 5, Osborne Street, Sanmers Road, Southsea.
1892, Apr. 29.	SIMPSON, ROBERT, 3, Aglionby Street, Carlisle.
1892, Dec. 17.	SKIDMORE, THOMAS, 24, Mawdsley Street, Bolton.
1892, June 25.	SLATER, WILLIAM, 79, Borough Gate, Otley.
1892, June 11.	SMITH, EMMETT, Mytholmroyd, Yorks.
1892, July 9.	SMITH, FRED. W., 92, St. Leonard Gate, Lancaster.
1892, Dec. 3.	SMITH, HAMILTON, 1, Oxford Road, Putney.
1892, Dec. 17.	SMITH, JAMES PERCY, Blue Coat Hospital, Liverpool.

1892, Apr. 9. SMITH, PERCY, 474, New Cross Road, S.E.
1892, Apr. 9. SMITH, RICHARD, Junr., Saltern Road, Parkstone, Dorset.
1892, June 11. SMITHIES, ARTHUR, Albert Avenue, Starbeck, Harrogate.
1892, Dec. 3. SOUTER, CHARLES, 7, David's Road, Forest Hill, S.E.
1892, Apr. 9. SPEARS, HENRY HORATIO, 48, Godwin Street, Birmingham.
1892, June 11. SPEIGHT, HARRY, Kirkhamgate, Wakefield.
1892, Apr. 9. SPINK, JOSEPH, Formby, Liverpool.
1892, Dec. 17. STEALEY, JOSEPH, 44, Wilmslow Road, Rusholme, Manchester.
1892, Apr. 9. STEWART, JAMES, 28, Crozier Street, Westminster Bridge Road.
1892, July 9. STEWART, ROBERT TOMLINSON, Thorpe-le-Soken, Essex.
1892, Dec. 17. STOREY, JOHN, 79, Premier Street, Liverpool.
1892, June 25. SURTEES, RICHARD T., Bolam Low House, Belsay, Newcastle-upon-Tyne.
1892, Apr. 9. SWEENEY, JOHN, 17, Brougham Street, Tranmere, Cheshire.
1892, July 9. THOMAS, GEORGE, 57, Loudoun Square, Cardiff.
1892, Dec. 17. THORNTON, RICHARD, Royal Albert Asylum, Lancaster.
1892, Apr. 29. TREADGOLD, WILLIAM JOSEPH, 37, Wilfred Street. Derby.
1892, June 11. TROW, SAMUEL, Sanitary Inspector, Otley.
1892, Dec. 3. TUFFEE, WILLIAM, Jun., 50, Parrock St., Gravesend.
1892, Dec. 3. WADMORE, ALICE, 15, Fairfax Road, South Hampstead.
1892, Dec. 3. WAKE, RICHARD, 619, Wandsworth Road, Clapham.
1892, Dec. 17. WALKER, ALLAN, 2, York Place, York Street, Wakefield.
1892, Dec. 3. WALKER, JAMES EDWARD, Vine Cottage, Hunstanton.
1892, June 11. WALKER, WALTER BURGESS, 3, Leamington Terrace, New Wortley, Leeds.
1892, Dec. 3. WALLIS, WILLIAM, 13, Gilbert Road, Kennington.
1892, Dec. 3. WANE, WILLIAM, 7, College Place, Crowndale Road, Camden Town.
1892, June 11. WARD, WALTER, 275, Bowling Old Lane, Bradford.
1892, Dec. 3. WARE, HENRY WICKS, Waterworks, Maidstone.
1892, Mar. 5. WARRAN, WILLIAM ERNEST, 5, Broad Park Terrace, Tavistock.
1892, July 9. WARREN, THOMAS WILLIAM, 17, Rawden Place, Cardiff.
1892, Dec. 3. WARREN, WILLIAM THOMAS, 23, Sturry Street, Poplar, E.
1892, June 25. WAUGH, MATTHEW, Scotch Arms Inn, Haydon Bridge, Northumberland.

1892, Apr. 9. Wells, William James, Kingswood, Reigate.
1892, June 25. Whieldon, Edmund, Blakeley Farm, Blythe Bridge, Stoke-on-Trent.
1892, June 11. Whinfield, Thomas Hood, Town Hall, Salford.
1892, July 9. White, Frank, 38, Maple Street, Northampton.
1892, Apr. 9. White, William, 27, Harvey Street, Folkestone.
1892, June 11. Whiteley, Thomas, Town Hall, Huddersfield.
1892, Mar. 5. Wilson, John Allen, 18, Rodney Terrace, Cheltenham.
1892, July 9. Windsor, William, 13, Sutcliffe Street, Liverpool, E.
1892, Apr. 9. Winsborrow, Edwin James, Town Hall, Westminster.
1892, Apr. 9. Wolters, William John, 62, Huntingdon Street, Barnsbury, N.
1892, Apr. 9. Wood, Charles Frederick, 1, Cedar Villas, West Hampstead.
1892, June 11. Woodhead, Fletcher, 13, Norman Street, Burnley.
1892, Dec. 3. Woolnough, Tom, Northolme, Aberdeen Road, Highbury.
1892, June 11. Wormald, John, Riding Head, Luddenden, *viâ* Manchester.
1892, Dec. 3. Wright, John Henry, Junr., 54, Caledonian Rd., N.
1892, June 25. Young, James, West Boldon, Newcastle-upon-Tyne.
1892, June 25. Young, Thomas, 17, California, Winlaton, Blaydon-on-Tyne.

EXHIBITIONS HELD IN CONNECTION WITH THE CONGRESSES OF THE INSTITUTE.

	1877. Leamington.	1878. Stafford.	1879. Croydon.	1880. Exeter.	1882. Newcastle.	1883. Glasgow.	1884. Dublin.	1885. Leicester.	1886. York.	1887. Bolton.	1889. Worcester.	1890. Brighton.	1892. Portsmouth.
Number of Exhibitors	117	116	189	106	110	126	134	135	130	112	108	108	156
Number of Exhibits	294	319	710	500	600	750	900	1,000	900	800	800	1,000	2,000
Space occupied (in square ft.)	......	......	......	9,725	14,520	20,000	40,000	30,000	30,000	25,000	28,000	30,000	35,000
Number of days Exhibition was open	14	16	17	19	25	25	19	17	26	29	23	18	24
Total number of Visitors	......	......	......	8,955	8,373	20,000	35,000	37,000	30,000	27,000	23,000	35,000	49,000
Number of Medals awarded	13	13	12	12	15	21	18	34	16	14	30	31*	17*
Number of Special Certificates	None.	6	9	7	4	13	11	11	12	9	None.	None.	None.
Number of Certificates	None.	22	38	40	72	58	83	79	64	40	71	86*	66*
Number of Exhibits deferred for further trial	......	7	52	30	37	44	39	119	42	46	67	67	38

* These do not include all the awards which may be given for Exhibits selected for further practical trial.

CONGRESS & EXHIBITION, PORTSMOUTH,

SEPTEMBER, 1892.

JUDGES' REPORT

OF MEDALS AND CERTIFICATES AWARDED.

DIVISION A.

SCIENCE IN RELATION TO HYGIENE.

Medals.

R. & J. Beck.
Improved Continental Microscope.

J. Swift & Sons.
Microscope Lamp.

DIVISION C.

CONSTRUCTION AND SANITARY APPARATUS.

CLASS I.

BUILDING MATERIALS, CONSTRUCTION & MACHINERY.

Medals.

J. Greenall.
Greenall's Steam Washer.

CLASS II.

WATER SUPPLY AND SEWERAGE.

Medals.

Broad & Co.
Enamelled Fireclay Water Cisterns.

Moule's Earth Closet Co.
Moule's Earth Closet.

CLASS III.

HEATING, LIGHTING, AND VENTILATION.

Medals.

Crompton & Co.
Apparatus for Cooking by Electricity.

Crompton & Co.
Domestic Motor.

DIVISION D.

PERSONAL AND DOMESTIC HYGIENE.

Medals.

BLONDEAU ET CIE.
Vinolia Toilet Soap.

SUTTON & SONS.
Vegetable Seeds.

WASHINGTON LYON.
Steam Disinfector.

MESSRS. CALVERT & CO.
Pure Carbolic Acid.

MORRIS TUBE AMMUNITION CO.
Morris Circulating Principle of Water Filtration.

NORTH WILTS DAIRY COMPANY.
Alpha Cream Separator.

NATHANIEL BLETCHLY.
Anatomical Boots.

BRAND & CO.
Beef Essences.

BROWN & POLSON.
Corn Flour.

BURROUGHS, WELLCOME & CO.
Travelling Medicine Chest.

DIVISION A.

SCIENCE IN RELATION TO HYGIENE.

Certificates of Merit.

J. DAVIS & CO.
American Forecast Barometer.

J. SWIFT & SONS.
Grove's Modification of Williams' Microtome.

DIVISION B.

HYGIENE OF SPECIAL CLASSES, TRADES, AND PROFESSIONS.

Certificates.

C. GROOM.
A Square Tent for Garden.

HUMPHREYS, LIMITED.
Iron Temporary Hospital Hut.

PORTSMOUTH WATER FITTINGS CO.
Water Curtain for Public Places of Entertainment.

ALFRED CARTER.
Model of Window with Removable Sashes to facilitate cleaning.

DIVISION C.

CONSTRUCTION AND SANITARY APPARATUS.

CLASS I.

BUILDING MATERIALS, CONSTRUCTION & MACHINERY.

Certificates.

S. S. Way.
Terra-Cotta Door and Window Jambs.

CLASS II.

WATER SUPPLY AND SEWERAGE.

Certificates.

Portsmouth Water Fittings Co.
Sir Wm. Thomson's (Lord Kelvin's) Water Tap.

Portsmouth Water Fittings Co.
Shanks' Enamelled Iron Bath.

Portsmouth Water Fittings Co.
Shanks' Independent Spray and Plunge Bath.

Broad & Co.
White Enamelled Fireclay Sink.

Broad & Co.
White Enamelled Straight and Curved Channels for Inspection Chambers to Drains.

The Trott Valve & Engineering Co.
Removable Valves for Hot and Cold Water Cocks.

The Trott Valve & Engineering Co.
Combined Bath Valve, with Interlocking Gear for Waste.

Geo. Jennings.
Cabinet Lavatory Stand.

Milne, Sons & Macfie.
Brass Siphon Traps.

Coleman & Morton.
Improved Tumbler Sanitary Cart.

Water Carriage Engineering Co.
Flush Indicator.

W. Clemens Abell & Co.
Balanced Water Cart.

Milne, Sons & Macfie.
Standing Waste and Overflow, with Trapping Bend for Bath.

Water Carriage Engineering Co.
Automatic Flushing Siphon, with Tipping Bucket at Outlet.

E. R. Palmer.
Palmer's Automatic Flushing Siphon.

Geo. Jennings.
Joint for Connecting Closet Basin to Metal Pipe.

J. Tylor & Sons.
Warwick Combined Slop Sink and W.C. with Lead Trap.

J. Tylor & Sons.
Lavatory with Lifting Standing Waste Outlet.

Portsmouth Water Fittings Co.
Shanks' "Citizen" Combined W.C. and Slop Sink with P Trap.

John Jones.
Condensation Seal Cover for Bottom of Manholes.

J. Tylor & Sons.
Silent Arrangement for "Tower" Waste Preventer.

John Knowles & Co.
The "Presto" Seat Action Siphon Waste Preventing Cistern.

Portsmouth Water Fittings Co.
Knight's Demonstration Model Showing Soil Pipe and Traps.

Portsmouth Water Fittings Co.
Tyndale's Rock Concrete Manholes for Sewers and Drains.

Portsmouth Water Fittings Co.
Trident Hopper Water Closet with P Trap.

Portsmouth Water Fittings Co.
Bayonet Joint for Connecting Closet Basin to Metal Pipe.

Portsmouth Water Fittings Co.
Shanks' Reliable Water Waste Preventing Cistern.

John Jones.
Bag Drain and Pipe Stopper.

John Jones.
Expanding Screw Drain and Pipe Stopper.

J. Chadwick.
Self-adjusting Tent Pole.

Samuel Grossmith.
The "Climax" Automatic Flushing Siphon.

CLASS III.

HEATING, LIGHTING AND VENTILATION.

Certificates.

Eagle Range & Foundry Co.
No. 35 Eagle Regulator, for Regulating Draught to Eagle Open Fire-grate.

Eagle Range & Foundry Co.
Indicating Damper to Eagle Range.

W. Sugg & Co.
" Westminster " Gas Cooking Stove, with Bunsen Burner.

Parkhouse Iron Co.
" Grecian " Kitchen Range.

Parkhouse Iron Co.
Dow's Kitchen Range.

Parkhouse Iron Co.
Dublin Kitchen Range.

Davis Gas Stove Co.
Thermo Hygienic Gas Stove.

T. Bailey, Junr.
Cyclone Geyser.

H. Sulley.
Noiseless Safety Pavement.

C. Kite & Co.
Improved Box Inlet Ventilator.

C. Kite & Co.
Lock Valve Inlet Ventilator.

DIVISION D.

PERSONAL AND DOMESTIC HYGIENE.

Certificates.

Burroughs, Wellcome & Co.
Malt Extracts.

J. J. Thornton & Co.
Men's India Rubber Boots, Ventilated and Lined with Felt.

J. J. Thornton & Co.
Down-covered Air Cushions.

Messrs. Mackey, Mackey & Co.
Oxychlorogene.

THE SANITAS CO.
Kingsett's Mercuric Bactericide.

T. TYRER & CO.
Preparations of Thiocamph.

BERKEFELD FILTER CO.
The Berkefeld Filter.

HOLDEN BROS.
Natureform Boots and Shoes for Children.

FRANCIS HY. KNIGHT, EUROPEAN DRESS CUTTING ASSOCIATION.
System of Hygienic Dress Cutting.

HERTS, SON & CO.
Hygienic Corsets.

E. CLARK & CO.
Coffee Extract.

JEYES' SANITARY COMPOUNDS COMPANY.
Jeyes' Fluid.

BUGLER & CO.
Disinfecting Sheet.

T. B. VERNON.
Ceres Automatic Letter and Card File Cabinet.

C. E. GITTENS, LIMITED.
Porcelain Screw Tap for Filter.

CADBURY BROS.
Cocoa Essence.

ARCTIC FREEZER CO.
Arctic Freezer.

The Judges desire to refer to the Specimens, displayed on the Walls of the Exhibition, of the Record Plans of the Sewerage and House Drainage of the Borough of Portsmouth, and to congratulate the Town Council on the way in which these Plans have been kept up, and on the possession of such a valuable record, not only of the Sewerage, but of the details of some thousands of House Drains.

Signed,

ERNEST TURNER, F.R.I.B.A., *Chairman.*

E. WHITE WALLIS, F.S.S., *Secretary.*

October, 1892.

THE SANITARY INSTITUTE.

The following was added to the Articles of Association of The Sanitary Institute, by Special Resolution passed 15th March, and confirmed April 4th, 1892 :—

50*a*. Notwithstanding anything hereinbefore contained, the Council may at any time, and from time to time, by a unanimous resolution of the members thereof present at a Meeting specially convened for the purpose, appoint any member of the Royal Family, or any member of Her Majesty's Government to hold and bear the title and discharge the duties of President of the Institute for such period as they may think fit, notwithstanding that the person so appointed is not a Fellow or Member of the Institute, and the person so appointed shall not by reason only of such appointment become a Member of the Institute. Provided that no such appointment shall continue for more than two years without the approval of a General Meeting.

50*b*. During the continuance in office of any person elected President in pursuance of Articles 44 to 50, no appointment shall be made under Article 50*a* without his consent being previously obtained, but upon such consent being given, and such appointment being made he shall immediately vacate his office of President.

LIST OF EXHIBITS

SELECTED BY THE JUDGES FOR FURTHER PRACTICAL TRIAL.

Shone's Hydro-Pneumatic Ejector.
Hughes & Lancaster.

Jackson's Grates and Stoves for Anthracite.
Gwaun Cae Gurwen Colliery Co.

Street Sweeping Machine with Scraper.
W. Clemens Abell & Co.

Hydraulic Cement from Sewage Sludge and Waste Gas Lime.
Arthur Angell.

Indurated Wood Fibre Tanks and Baths.
Milne, Son & Macfie.

Double Action Road Sweeping Machine.
Coleman & Morton.

Tea.
Mazawattee Ceylon Tea Co.

Mineral Waters.
C. Mumby & Co.

Mineral Waters.
C. F. Perkins.

Rain Water Separator.
Chas. G. Roberts.

Non-concussive and Self-closing Valve.
Trott Valve Engineering Co.

Outlet and Inlet Ventilator for Torpedo Vessels.
Wm. Sugg & Co.

System of Ventilating Buildings.
Wm. Sugg & Co.

Sun Knife Cleaner.
Sun Knife Cleaner Co.

Eureka Aerated Flour.
Coombe's Eureka Flour Co.

Prof. Wolpert's Smoke Exhauster.
H. Heim.

Ventilators (except Bracket).
Wheeler & Son.

D.D. Ventilating Chimney Top.
John Jas. Downes.

Ventilating Cowls.
C. Kite & Co.

Leggott & Marsh's Smoke Consuming Fire.
Economic Smokeless Fire Co.

Closet of the Century.
Geo. Jennings.

Sykes' Screw Joint for Earthenware Pipes.
The Albion Clay Co.

Paragon Joint for Earthenware Pipes.
The Albion Clay Co.

Silent Water Waste Preventer.
D. T. Bostel & Sons.

Quick-filling Siphon Action Cistern with after Flush.
Geo. Jennings.

Non-pneumatic Peckham Waste Preventing Cistern.
Milton Syer.

Roof Ridge Ventilator.
C. Kite & Co.

Under-Roof Ventilator.
C. Kite & Co.

Exhaust Ventilator.
C. Kite & Co.

Downcast Inlet Ventilator.
C. Kite & Co.

New Simplex Water-jet Air Propeller.
C. Kite & Co.

The Volume Fan.
Wheeler & Son.

Electric Motor for Ventilating Purposes.
Mackey, Mackey & Co.

Simmorell's Updraught Ventilator.
Wm. Sugg & Co.

Injector Cowl.
Wm. Sugg & Co.

Mosquera Julia Food.
Mosquera Julia Food Co.

Scott's Midlothian Oat Flour.
Andrew Scott & J. C. Lauder.

Blackman Ventilating Fan.
Blackman Ventilating Co.

CONTRIBUTIONS TO LIBRARY DURING 1892.

In addition to the works enumerated in the following list, valuable donations of Foreign Reports and other official publications have been received from the International Congress of Hygiene and Demography, London, Prof. W. H. Corfield, M.A., M.D., and G. J. Symons, F.R.S.

*** *For publications of Societies and Institutions, &c., see under "Academies."*

ACADEMIES, ASSOCIATIONS, COLLEGES, SOCIETIES, &c.

ACADEMIES (AMERICAN).

Concord. *American Public Health Association.* Public Health Papers and Reports, Vol. XVII., 1891. 321 p. 8vo. Concord, 1892. *The Association.*

Manitoba, *Historical and Scientific Society.* Annual Reports for the years 1890, 1891, and 1892. 10 p., 8vo. Winnipeg, 1891. *The Society.*

——— *Historical and Scientific Society.* Older Geology of the Red River and Assiniboine Valleys. Paper by G. Bryce, LL.D., 8 p., 8vo. Winnipeg, 1891. *The Society.*

——— *Historical and Scientific Society.* An Account of the affair of Sevenoaks; the circumstances which led up to it; the Events and Conflict. 38 p., 8vo. Winnipeg, 1891. *The Society.*

——— *Historical and Scientific Society.* The First Recorder of Rupert's Land. A Paper read before the Society on May 4th, 1890, by G. Bryce, LL.D. 5 p., 8vo. *The Society.*

——— *Historical and Scientific Society.* Surface Geology of the Red River and Assiniboine Valleys. A Paper read before the Society on January 22nd, 1891, by G. Bryce, LL.D. 7 p., 8vo. *The Society.*

Massachusetts, *Institute of Technology.* Technology Quarterly and Proceedings of the Society of Arts, 1892. 8vo. Boston, 1892. *The Institute.*

Philadelphia. *College of Physicians.* Transactions, Vol. XIII., Third Series. 179 p., 8vo. Philadelphia, 1891. *The College.*

Toronto, *Canadian Institute.* Annual Archæological Report (Session 1891), being an Appendix to the Report of the Minister of Education, Ontario. 101 p., 8vo. Toronto, 1891. *The Institute.*

——— *Canadian Institute.* Transactions, 1892, Vol. II., Part II., and Vol. III., Part I. 363 p., 8vo. Toronto, 1892. *The Institute.*

ACADEMIES (Australian).

New South Wales. *Australian Museum.* Report of Trustees for the year 1890. 33 p., f. cap. 1891.

——— *Royal Society of.* Journal and Proceedings, Vol. XXV., 1891. 345 p., 8vo. Sydney, 1892. *The Society.*

——— *Department of Public Instruction.* Report of the Curator of the Technological Museum for 1890. 52 p., f. cap. Sydney, 1892.

ACADEMIES (British).

Chatham. *Royal Engineers' Society.* Professional Papers of the Corps of Royal Engineers. Occasional Papers, Vol. XVII. 1891. 238 p. (plates), 8vo. Chatham, 1892. *Royal Engineers' Institute.*

Glasgow. *Institution of Engineers and Shipbuilders in Scotland.* Transactions, Vol. XXXV., 1891—92. 388 p., 8vo. (plates). Glasgow, 1892. *The Institute.*

London. *Anthropological Institute.* Journal, 1875-82, 1884, 1886-90. *Sir Douglas Galton.*

——— *Architects' Society of.* Proceedings, 1892. 8vo. London. *The Society.*

——— *Chemical Society, Journal of,* 1875-87 and 1889. *Sir Douglas Galton.*

——— *City of London College.* Calendar for 1892—93. 191 p., 8vo. London, 1892. *The College.*

——— *Engineers' Society of.* Transactions for 1891. 243 p., 8vo. London, 1892. *The Society.*

——— *Incorporated Association of Municipal and County Engineers.* Proceedings, Vol. XVIII. 441 p., 8vo. London, 1892. *The Association.*

——— *Medical Society of.* Transactions, Vol. XV. 483 p. London, 1892. *The Society.*

——— *Society of Medical Officers of Health.* Transactions. Session, 1883—6. 135 p., 8vo. London, 1886. *Miss Greenhow.*

——— *Royal Botanic Society.* Quarterly Record for 1880 to 1891. 4 Vols. *The Society.*

——— *Royal College of Surgeons of England.* Calendar for 1892. 397 p., 8vo. London, 1892. *The College.*

——— *Royal Institute of British Architects.* Transactions, Vol. VIII., 1892. 434 p., 4to. London, 1892. *The Institute.*

——— *Royal Institution of Great Britain.* Proceedings, Vol. XIII., Part II. 250 p., 8vo. London, 1892. *The Royal Institution.*

——— *Royal Statistical Society.* Journal, Vol. LV. p., 8vo. London. *The Society.*

London. *St. Thomas's Hospital.* Reports, New Series, Vol. XX. 520 p., 8vo. London, 1892. *The Hospital.*

——— *The Surveyors' Institution.* Transactions, Session 1891—92. 8vo. London. *The Institution.*

——— *University College.* Calendar, Session 1892—93. 410 p., 8vo. London, 1892. *The College.*

Newcastle-on-Tyne. *North of England Institute of Mining and Mechanical Engineers.* Transactions, 1892. *The Institute.*

ACADEMIES (CONTINENTAL).

Amsterdam. *Koninkligke Akademie Van Wetenchappen.* Verslagen en Mededeelingen, der Vol. VIII. 627 p., 8vo. Amsterdam, 1891. *Royal Academy of Sciences.*

Rome. *R. Università.* Annali dell' Istituto d' Igiene Sperimentale. Vol. I. 8vo. Roma, 1892. *Prof. Angelo Celli.*

Abney's *Chemistry of Building Materials.* Notes on the Third Edition, revised by Capt. S. M. Maycock, R.E. 155 p., 8vo. Chatham, 1888. *Purchased.*

Acland, *Dr. H. N.* Memoir on the Cholera at Oxford in the year 1854, with Considerations suggested by the Epidemic. 172 p. (maps). London, 1856. *Miss Greenhow.*

Army Hospital Services Enquiry Committee. Report and Minutes of Evidence, Appendix and Index. 771 p., f. cap. London, 1883. *Miss Greenhow.*

Bidlake, *W. H.* Dry Rot in Timber. 24 p., 8vo. London, 1889. *Purchased.*

Blair, *Dr. J. A.* The Organic Analysis of Potable Waters. 120 p., 8vo. London, 1891. *The Author.*

Board of Agriculture. Agricultural Returns of Great Britain, with abstract returns for the United Kingdom, British Possessions and Foreign Countries, 1891. 187 p., 8vo. London, 1891. *The Board.*

——— Agricultural Produce Statistics of Great Britain, showing the estimated total produce and average yield per acre of the principal crops, with abstract returns for the United Kingdom, 1891. 33 p., 8vo. London, 1892. *The Board.*

——— Agricultural Returns for 1892. 37 p., 8vo. London, 1892. *The Board.*

——— Annual Report of the Director of the Veterinary Department for the year 1891, with an Appendix. 205 p., 8vo. London, 1892. *Prof. G. T. Brown.*

Bucharest. Raport General asupra Igienei Publice si asupra Serviciului Sanitar al Capitalei per anul 1891. 136 p., 8vo. Bucharest, 1892. *Dr. J. Felix.*

Canada. *Inland Revenue Department, Laboratory of.* Bulletins Nos. 1 to 30, 1887—1892. *Laboratory of the Inland Revenue.*

Canada. *Inland Revenue Department, Laboratory of.* Act respecting Adulteration of Food, Drugs, and Agricultural Fertilizers, 1886, and Amending Acts. *Laboratory of the Inland Revenue.*

——— *Inland Revenue Department, Laboratory of.* Act respecting Agricultural Fertilizers, 1890. *Laboratory of the Inland Revenue.*

Cattle Plague. Third Report of the Commissioners appointed to inquire into the Origin and Nature, &c., of, with an Appendix. 244 p., f. cap. London, 1866. *Miss Greenhow.*

Cholera Epidemic. Report on the, as it has appeared in the Territories subject to the Presidency of Fort St. George (Madras). 212 p., 8vo. London, 1849. *Miss Greenhow.*

——— A Report on the Outbreak in Brecon in 1854, by Dr. Lucas Prestwood. 27 p., 8vo. London, 1855. *Miss Greenhow.*

——— **of 1854.** Report on, as it prevailed in the City of London, by J. Simon. 19 p., 8vo. London, 1854. *Miss Greenhow.*

Cholera Epidemics of London. Report on the last two, as affected by the consumption of Impure Water. 35 p., 8vo. London, 1856. *Miss Greenhow.*

Cholera. Report of the Commissioners appointed to inquire into the causes which have led to and have aggravated the late Outbreak of Cholera in the towns of Newcastle-upon-Tyne, Gateshead, and Tynemouth. 580 p., f. cap. London, 1854. *Miss Greenhow.*

——— General Board of Health Reports, 1848—49. 500 p., 8vo. London, 1848—49. *Miss Greenhow.*

——— Report on the Mortality of, in England, 1848—49. 300 p., 8vo. London, 1852. *Miss Greenhow.*

——— Returns in Great Britain in the year 1832 (manuscript). *Miss Greenhow.*

——— **in Tynemouth** in 1831–2, 1848–9, and 1853, by Dr. E. Headlam Greenhow. 26 p., 8vo. Excerpt, Journal of Public Health, June, 1855. *Miss Greenhow.*

——— Report on the Outbreak in the Parish of St. James, Westminster, during the Autumn of 1854. 171 p., 8vo. (maps and diagrams). London, 1855. *Miss Greenhow.*

——— Quarantine and the Plague, being a Summary of the Report on these subjects recently addressed to the Royal Academy of Medicine in France, with introductory observations, extracts from Parliamentary Correspondence, and Notes, by Dr. Gavin Milroy. 71 p., 8vo. London, 1846. *Miss Greenhow.*

——— The Cholera not to be arrested by Quarantine; a brief historical sketch of the great Epidemic of 1817 and its invasions of Europe in 1831-2 and 1847, with practical remarks on the treatment, preventive and curative, of the disease. 51 p., 8vo. London, 1847. *Miss Greenhow.*

——— **Ireland.** Report of the Commissioners of Health on the Epidemics of 1846 and 1850. 79 p., 8vo. Dublin, 1852. *Miss Greenhow.*

Clarke, *J. W.* Clarke's Tables (for pocket). London, 1891. *The Author.*

Colyer, *F.* Public Institutions: their Engineering, Sanitary, and other Appliances. 219 p., 8vo. London, 1889. *The Author.*

——— Treatise on Water Supply, Drainage, and Sanitary Appliances of Residences. 92 p., 8vo. London, 1889. *The Author.*

Cornel, *A.* Celsus et q. serenus Samonicus de Medicina. 593 p., 16mo. 1713. *Miss Greenhow.*

Contagious Diseases Acts. Report from the Select Committee on, together with the Proceedings of the Committee, Minutes of Evidence, and Appendix and Index to the Report. 750 p., f. cap. London, 1882. *Miss Greenhow.*

Convicts, Employment of, in the United Kingdom. Report of a Committee appointed to consider certain questions relating to. 45 p. (maps), f. cap. London, 1882. *Miss Greenhow.*

——— Report of the Commissioners appointed to inquire into the treatment of Treason and Felony Convicts in English Prisons, together with Appendix and Minutes of Evidence. Vol. I.—The Report and Evidence, 60 p., f. cap. London, 1871. Vol. II.—Minutes of Evidence, 538 p., f. cap. London, 1870. *Miss Greenhow.*

Deaths from specified causes in England and Wales. Average Annual Proportion during the ten years, 1851—60. Folio. *Miss Greenhow.*

——— Annual Proportion during the ten years, 1861—70. Folio. *Miss Greenhow.*

Dublin. Report of the Public Health Committee, Jan. 21st, 1892 (containing statement concerning Typhoid Fever Epidemic by W. R. Maguire). 44 p., 8vo. Dublin, 1892. *W. R. Maguire.*

Dukes, *Dr. Clement.* The Preservation of Health. 222 p., 8vo. London, 1883. *The Author.*

——— The Essentials of School Diet. 187 p., 8vo. London, 1891. *The Author.*

Dulier, *Col.* Smoke and Fogs; a natural process of dissolution of. 7 p., 8vo. London. *The Author.*

Dye, *F.* A Practical Treatise upon Warming Buildings by Hot Water. 512 p., 8vo. London, 1891. *The Author.*

Egglestone, *Wm.* House Drainage and Sanitary Catalogue. 68 p., 8vo. Stanhope, 1889. *The Author.*

——— Weardale, Names of Field and Fell. 168 p., 8vo. Stanhope, 1886. *The Author.*

Factories and Workshops. Report of the Chief Inspector to Her Majesty's Principal Secretary of State for the Home Department for the year ending 31st October, 1887. 292 p., 8vo. London, 1888. *Miss Greenhow.*

Fayrer, *Sir Joseph.* Presidential Address, Section I. Preventive Medicine, International Congress of Hygiene. 10 p., 8vo. London, 1891. *The Author.*

Field, *Rogers.* Practical Suggestions as to the Water Supply, Drainage, and Sewage Disposal of Lunatic Asylums, issued by the Commissioners in Lunacy. 17 p., 8vo. London, 1892. *The Author.*

Fleming, *Sandford.* An Appeal to the Canadian Institute on the Rectification of Parliament. 173 p., 8vo. Toronto, 1892. *The Canadian Institute.*

Fletcher, *Prof. Banister.* Quantities. 268 p. (plates), 8vo. London, 1888. *The Author.*

——— Metropolitan Building Acts. 219 p., 8vo. London, 1882. *The Author.*

Fleury, *Louis.* Cours d'hygiene fait à la faculté de médicine de Paris. 679 p., 8vo. Paris, 1852—53. *Miss Greenhow.*

Fyfe, *Peter.* The Progress of Death in Scotland and her Counties since 1855, a comparison. 14 p. (tables and map), 8vo. Glasgow, 1892. *The Author.*

Garrett, *E.* The Law of Nuisances, 548 p., 8vo. London, 1890. *The Author.*

Gillespie, *Rev. C, G. R.* The Claims of Sanitary Science upon Clergy. 23 p., 8vo. London, 1891. *The Author.*

Grant, *John.* On the Strength of Cement. 172 p. (plates), 8vo. London, 1875. *Purchased.*

Guy, *W. A.* Results of the Censuses of the Population of Convict Prisons in England, taken in 1862 and 1873. 38 p., 8vo. London, 1875. *Miss Greenhow.*

Hall, *E. T.* Some Chief Causes of the Unhealthiness of Cities, with Suggestions for their Removal. 31 p., 8vo. Reprint from the "Contemporary Review," February, 1892. *The Author.*

Heberden, *Dr. W.* Observations on the Increase and Decrease of different Diseases, and particularly of the Plague. 151 p., 4to. London, 1801. *Miss Greenhow.*

Hehir, *Dr. Patrick.* Microscopical Observations on the Hœmotozöon of Malaria, with an appendix containing a series of plates, illustrations, and descriptions. 27 p., 4to. Hyderabad, 1892. *The Author.*

——— Microscopical Observations on the Hœmotozöon of Malaria. 27 p. (plates), 4to. Hyderabad, 1891. *The Author.*

Hellyer, *S. S.* Principles and Practice of Plumbing. 294 p., 8vo. London, 1891. *The Author.*

Hurst, *John Thomas.* Architectural Surveyors' Handbook. 477 p. London, 1892. *Purchased.*

Hygieine. Dissertatio de, 320 p., 16mo. 1710. *Purchased.*

——— and Public Health, a Treatise on, Vol. I. 1013 p., 8vo. London, 1892. *J. & A. Churchill.*

Iowa *State Board of Health.* Monthly Bulletin, 1892. *The Board.*

Ireland. Medical Charities: Third Annual Report of the Commissioners for administering the laws for relief of the poor in Ireland. 381 p., 8vo. Dublin, 1855. *Miss Greenhow.*

James, *Dr. R.* Diseases of Tradesmen. 432 p., 16mo. London, 1750. *Miss Greenhow.*

Japan. The Annual Report of the Imperial Navy for the 23rd year of Meiji, 1890. 60 p., 8vo. Tokyo, 1891. *K. Takaki, Director-General.*

——— Review of the Preventive Measures taken against Kak'ke in the Imperial Navy. 42 p., 8vo. Tokyo, 1890. *K. Takaki.*

Kansas, *State Board of Health.* Seventh Annual Report from January 1st, 1891, to December 31st, 1891. 230 p., 8vo. Topeka, 1892. *The Board.*

Leprosy. Medical Reports upon the Character and Progress of, in the East Indies, being answers to interrogatories drawn up by the Royal College of Physicians, London. 500 p., f. cap. Calcutta, 1865. *Miss Greenhow.*

——— Report on, by the Royal College of Physicians, prepared for Her Majesty's Secretary of State for the Colonies, with an Appendix. 344 p., f. cap. London, 1867. *Miss Greenhow.*

Local Government Board. Mr. R. D. R. Sweeting's Report to the Local Government Board on an Outbreak of Diphtheria at Bourdon Buildings, in the Parish of St. George, Hanover Square. 8 p., f. cap. London, 1891.

——— Twentieth Annual Report of the Local Government Board, 1890—91. Supplement containing the Report of the Medical Officer for 1890. 296 p., 8vo. London, 1891.

——— Tabular Statement of Workhouse Dietaries, Lancashire, 1890. 59 p., f. cap. London, 1891.

——— Points to be attended to on the Construction of Workhouse Buildings. 12 p., f. cap. London, 1891.

——— Nursing in Workhouse Sick Wards. 2 p., f. cap. London, 1892.

——— Tabular Statement of Workhouse Dietaries, Kent, 1890. 24 p., f. cap. London, 1891.

——— *Medical Department.* Mr. T. W. Thompson's Report to the Local Government Board of the Sanitary Circumstances of the Crownhill's Urban Sanitary District, and upon Administration by the Sanitary Authority. 6 p., f. cap. London, June, 1892.

——— Dr. Parson's Report on the Prevalence of Enteric Fever and Diphtheria in the Ashby-de-la-Zouch Rural Sanitary District. 10 p., f. cap. London, June, 1892.

——— Dr. Theodore Thomson's Report on the General Sanitary Condition of the Aylesbury Rural Sanitary District. 9 p., f. cap. London, August, 1892.

——— Dr. Theodore Thomson's Report on an Outbreak of Enteric Fever in the Urban Sanitary Districts of Rotherham, Rawmarsh, and Greasbrough, in the West Riding of Yorkshire. 20 p., f. cap. London, August, 1892.

——— Dr. S. Monckton Copeman's Report on an Outbreak of Typhus Fever in the Wigan and Ince-in-Makerfield Urban Sanitary Districts. 14 p. (charts) f. cap. London, October, 1892.

——— Dr. Parsons' Report on an Outbreak of Typhoid Fever at Newfield Moira, in the District of the Ashby Would Local Board. 4 p., f. cap. London, June, 1892.

——— Dr. Bruce Low's Report on an Outbreak of Typhoid Fever in the Borough of King's Lynn, Norfolk. 21 p., f. cap. London, August, 1892. *The Board.*

London, *City of.* Ten years growth of, 1881-1891. Report of the Day Census, 1891. 139 p., 8vo. London, 1891. *J. D. Mathews.*

London *Water Supply.* Minutes of Proceedings before the Committee for County Purposes of the Court of Common Council on the Question of Water Supply, and Report to the Court of Common Council from the County Purposes Committee, October 16th, 1890. 417 p., f. cap. London, 1890. *County Purposes Committee—per Sir J. Monckton.*

Longstaff, *Dr. G. B.* Studies in Statistics—Social, Political, and Medical. 455 p., 8vo. London, 1891. *The Author.*

Macleod, *Miss.* "Life or Death; or, Inspired Thoughts on Scientific Subjects." 303 p., 8vo. London. 1892. *The Author.*

Maguire, *T. M.* London Householder's Chart. 20 p., 8vo. London, 1891. *Purchased.*

Massachusetts, *State Board of Health.* Forty-ninth Annual Report to the Legislature of Massachusetts, relating to the registry and return of Births, Marriages, and Deaths in the Commonwealth for the year ending December 31st, 1890. 421 p., 8vo. Boston, 1891. *State Board of Health.*

——— *State Board of Health.* Twenty-Third Annual Report. 927 p., 8vo. Boston, 1892. *The Board.*

McWilliam, *Dr. J. O.* Medical History of the Expedition to the Niger during the years 1841—2, comprising an Account of the Fever which led to its abrupt termination. 287 p., 8vo. London, 1843. *Miss Greenhow.*

Medical Acts. Report of the Royal Commissioners appointed to inquire into the, with Minutes of Evidence, Appendices and Index. 430 p., f. cap. London, 1882. *Miss Greenhow.*

MEDICAL OFFICERS', ANALYSTS', AND SANITARY INSPECTORS' REPORTS.

	Year.	
Aberdeen, *City of*	February, 1892.	*Dr. M. Hay.*
Aberdeen	,,	,,
Acton Local Board	1891.	*W. B. Prowse.*
Birkenhead	,,	*Francis Vacher.*
Birmingham	,,	*Dr. A. Hill.*
Blackpool	,,	*Dr. A. J. Anderson.*
Bolton	,,	*Dr. F. E. Adams.*
Calcutta	,,	*Dr. W. J. Simpson.*
Chelmsford	,,	*Dr. J. C. Thresh.*
Cornwall	,,	*S. Trevail.*
Cromer Urban Sanitary District	,,	*S. T. Taylor.*
Dumbarton, *County Council for*	,,	*Dr. J. C. McVail.*
Dublin	,,	*Sir Charles Cameron.*
Erpingham Union	,,	*S. T. Taylor.*
Essex, County of	,,	*Dr. J. C. Thresh.*
Hastings	,,	*G. R. Meadows.*

MEDICAL OFFICERS', &c., REPORT.—*Continued.*

Kensington	.. ..	1891.	*Dr. T. O. Dudfield.*
Kidderminster	.. ..	1886—92	*J. T. Cowderoy.*
Lambeth	.. .. ..	1890.	*Dr. H. W. Verdon.*
Liverpool Port Sanitary Authority	.. ..	1891.	*Dr. J. Stopford Taylor.*
Liverpool	.. .. ..	„	„
Merthyr Tydfil	.. ..	„	*T. J. Dyke.*

Paddington, 1863, 1864, half years ending 1865, 1866, ditto monthly reports during 1863 (imperfect) *Prof. W. H. Corfield.*

River Tyne Port Sanitary Authority	.. ..	1891.	*Dr. H. E. Armstrong.*
Scarborough (Rural)..	..	„	*Dr. R. Cuff.*
Stirling County Council.	..	„	*Dr. J. C. McVail.*
St. Faith's Union	.. ..	„	*S. T. Taylor.*
St. George's, Hanover Square (Analyst's)	.. ..	„	*C. E. Cassal.*

St. Pancras. Report upon the outbreak of Enteric Fever at the Foundling Hospital .. *Dr. J. F. J. Sykes.*

Torquay	.. .. ..	1891.	*P. Q. Karkeek.*
Wandsworth	.. ..	„	*The Board.*
Warwick, County of	..	„	*Prof. A. B. Hill.*
Watford	.. .. ..	„	*Dr. A. T. Brett.*
West Riding County Council		1890.	*Dr. Whitelegge.*
West Sussex	.. ..	1891.	*Dr. C. Kelly.*
Whitechapel District.	..	„	*Dr. Joseph Loane.*
Wolverhampton	.. ..	„	*E. J. Franks.*
Wolverhampton	.. ..	1892.	*Dr. H. Malet.*

Metropolitan Asylums Board. Reports for the year 1891 of the Statistical Committee and Medical Superintendents. 180 p., 8vo. London, 1892. *The Board.*

Middleton, *G. A. T.* House Drainage. 63 p., 8vo. London, 1892. *The Author.*

Mines in Great Britain. Report of the Commissioners appointed to inquire into the condition of, to which the Provisions of the Act do not apply with reference to the health and safety of persons employed in such Mines, with Appendices. 24 p. (plates), 8vo. London, 1864. *Miss Greenhow.*

——— Minutes of Evidence of the above. 529 p., f. cap. London, 1864. *Miss Greenhow.*

——— Epitome of Evidence of the above. 299 p., f. cap. London, 1864. *Miss Greenhow.*

——— Appendix B of the above. 446 p., f. cap. London, 1864. *Miss Greenhow.*

Mitchell, *Charles F.* Forty Plates on Building Construction. 40 p., demy. London, 1891. *The Author.*

Molesworth, *Sir Guildford L.* Pocket-book of Engineering Formulæ. 763 p. London, 1891. *Purchased.*

Mortality, Tables of. Experience of, from 1847—1884, compiled by The British Empire Mutual Life Assurance Company. 40 p., f. cap. London, 1874. *Miss Greenhow.*

Murphy, *Shirley F.* Our Homes, and how to make them Healthy. 947 p., 8vo. London, 1885. *Purchased.*

Netherlands. Le 7me congrès International d'Hygiene et de Démographie tenu a Londres du 10 au 17 aout 1891. Rapport présentè A. M. le Ministre de l'intérieur des pays-bas par MM. les Docteurs G. von. Overbeek de Meyer, W. P. Ruysch, et C. Stékoulis, délégués. 79 p., 8vo. Bruges, 1892. *Dr. Overbeek de Meyer.*

Newsholme, *Dr. A.* Hygiene: a Manual of Personal and Public Health. 448 p., 8vo. London, 1892. *The Author.*

New Jersey, *State Board of Health.* Fifteenth Annual Report for 1891. 489 p., 8vo. Trenton (N.J.), 1891. *The Board.*

New York, *State Board of Health.* Monthly Bulletin, 1892. *The Board.*

New South Wales. Annual Report of the Department of Mines and Agriculture for the year 1891. 322 p., f. cap. Sydney, 1892. *Agent-General for New South Wales.*

Nottingham. The Meteorology of, for the year 1891. 3 p. (tables), f. cap. Nottingham, 1892. *A. Brown.*

——— Meteorology for 1891. (Tables and Diagram), folio. *Dr. P. Boobbyer.*

Parkes, *Dr. Louis.* Hygiene and Public Health. 3rd Edit., 523 p., 8vo. London, 1892. *The Author.*

Parry, *J.* Water Supply. 184 p., 8vo. London, 1890. *G. Phillip & Son.*

Patterson, *Dr. T.* On the Abolition of Smoke from Steam Boilers. 43 p., 8vo. Oldham, 1891. *The Author.*

Penal Servitude Acts Commission. Report of the Commissioners appointed to inquire into the working of the Penal Servitude Acts. Vol. I.—Commissions and Report. 66 p. 8vo. London, 1879. Vol. II.—Minutes of Evidence. 699 p., 8vo. London, 1879. Vol. III.—Minutes of Evidence (*con.*) and Appendix, together with Analysis of Evidence and Appendix. 640 p., 8vo. London, 1879. *Miss Greenhow.*

Penal Servitude and Transportation. Report of the Commissioners appointed to inquire into the operation of the Acts relating to,
Vol. I.—Report and Appendix. 281 p., 8vo.
Vol. II.—Minutes and Evidence. 658 p., 8vo.
——— Index of Evidence and Appendix. 35 p., f. cap.
——— Report. 44 p., f. cap. London, 1863. *Miss Greenhow.*

Price, *J.* Scavenging and Disposal of Refuse, Lecture on. 27 p., 8vo. Liverpool, 1892. *The Author.*

Pringle, *Dr. John.* Observations on the Diseases of the Army. 500 p., 8vo. London, 1764. *Miss Greenhow.*

Prisons, *Commissioners of.* Reports with Appendix. Ninth, for year ending March 31st, 1886, 195 p., 8vo. London, 1886. Tenth, for year ending March 31st, 1887, 229 p., 8vo. London, 1887. Eleventh, for year ending March 31st, 1888, 304 p., 8vo. London, 1888. *Miss Greenhow.*

——— *Royal Commission on, in Ireland.* Vol. I.—Reports with Digest of Evidence and Appendices. 258 p., f. cap. Dublin, 1884. Second Report. 34 p., f. cap. London, 1884. Vol. II.—Minutes of Evidence. 519 p., f. cap. London, 1884. *Miss Greenhow.*

——— **(Convict)**, *Directors of.* Reports with Appendix for year 1886—7, 133 p., 8vo. London, 1887. For year 1887—8, 147 p., 8vo. London, 1888. *Miss Greenhow.*

——— **(Convict)**, Reports on the Discipline and Management of, for year 1875, 609 p., 8vo. London, 1876. For year 1876, 634 p., 8vo. London, 1877. For year 1877, 597 p., 8vo. London, 1878. For year 1879—80, 1011 p., 8vo. London, 1880. For year 1880—81, 640 p., 8vo. London, 1881. For year 1885—86, 284 p., 8vo. London, 1886. *Miss Greenhow.*

——— **(Convict)**, *Directors of, for Ireland.* Annual Reports with Appendix for the following years ending December 31st. 1865, 78 p., 8vo. Dublin, 1886. 1866, 75 p., 8vo. Dublin, 1867. 1875, 48 p., 8vo. Dublin, 1876. 1876, 47 p., 8vo. Dublin, 1877. 1877, 49 p., 8vo. Dublin, 1878. *Miss Greenhow.*

——— **(Military)**. Report on the Discipline and Management of, for 1885, 37 p., 8vo. London, 1886. For 1886, 44 p., 8vo. London, 1887. *Miss Greenhow.*

Prison Discipline. Copies of Correspondence between the Secretary of State for the Home Department and the Inspectors of Prisons relating to the Report of the Select Committee of the House of Lords on Prison Discipline and of the Report of a Committee appointed by the Secretary of State to inquire into the Dietaries of County and Borough Prisons. 78 p., f. cap. London, 1864. *Miss Greenhow.*

Privy Council and Local Government Board. Reprints from Reports of the Medical Department for the years 1865—6 and 1873. 35 p., 8vo. London, 1884. *Miss Greenhow.*

Putzeys, *Dr. Felix.* La Construction des Casernes. 364 p., 8vo. 8vo. Liege, 1892. (With folio of plans). *The Author.*

Quarantine, *General Board of Health.* Reports on 1848—54. 300 p., 8vo. London, 1848—54. *Miss Greenhow.*

Registrar-General, *Scotland.* Thirty-fifth detailed Annual Report of Births, Deaths, and Marriages in Scotland. 459 p., 8vo. Edinburgh, 1891. Weekly, Monthly, and Quarterly, 1892.

——— *England.* Weekly and Quarterly, 1892.

——— *Ireland.* Quarterly Returns, 1891; Weekly and Quarterly Returns, 1892. *Registrar-General.*

Reid, *Dr. G.* Practical Sanitation. 300 p., 8vo. London, 1892. *The Author.*

Rivers Pollution Prevention Act, 1876. Second Report to Local Government Board, by Dr. Angus Smith, on the Examination of Waters. 38 p. (plates), 8vo. London, 1884. *Miss Greenhow.*

Rivington's *Building Construction*, Notes on. Parts I, II, and IV. 955 p., 8vo. London, 1891. *Purchased.*

Rome. La Ricerca del Gittajone e di alcuni altri semi ed elementi eterogenei nelle farine stacciate. 14 p., f. cap. Roma, 1892. *Ministero dell' Interno.*

——— Di alcune nuove proprietà dello spirillo colerigeno di Koch e degli spirilli affini di Metschnikoff, Di Finkler e di Deneke nota del Dott Achille Sclavo. 15 p., 4to. 1892. *Ministero dell' Interno.*

——— Studi sperimentali sul latte nota preventiva dell Dott C. Gorini. 3 p., 4to. *Ministero dell' Interno.*

——— Direzione della sanita pubblicas Istruzioni per prevenire lo sviluppo e la diffusione del Colera nei Comuni del Regno. 15 p., 4to. September, 1892. *Ministero dell' Interno.*

——— Azione di alcune muffe sui composti fissi d'arsenico pel Dott B. Gosio. 32 p., 4to. Roma, 1892. *Ministero dell' Interno.*

——— Di alcune differenze esistenti fra gli spirilli del colera isolati in diverse epidemie. 12 p., 4to. 1892. *Ministero dell' Interno.*

——— Di un nuovo apparecchio per la presa dell' acqua, a profondità. 6 p., 4to. Roma, 1892. *Ministero dell' Interno.*

——— Della conversazione dei virus in glicerina. 7 p., 4to. Roma, 1891. *Ministero dell' Interno.*

Russell, *Hon. Rollo.* Epidemics, Plagues and Fevers, their Causes and Prevention. 508 p., 8vo. London, 1892. *The Author.*

Sanitary Commission dispatched to the Seat of War in the East. 1855-56. Report of the Proceedings of. 301 p., 8vo. London, 1857. *Miss Greenhow.*

School Ventilation, The problem of, with special reference to Ventilation by mechanical means. A Paper read before a Conference of School Board Clerks, Brighton, 1886. 20 p., 8vo. *W. Whitaker.*

Shapter, *Dr. T.* The History of the Cholera in Exeter in 1832. 296 p., 8vo. London, 1849. *Miss Greenhow.*

Shone, *Isaac.* The "Shone" System of Town Drainage. A Paper read before the Incorporated Association of Municipal and County Engineers, Peterborough, June, 1892. 24 p., 16mo. *The Author.*

Simon, *Sir John.* Reports relating to the Sanitary Condition of the City of London. 312 p., 8vo. London, 1854. *Miss Greenhow.*

Small Pox and Fever Hospitals. Report of the Commissioners appointed to inquire respecting, with Minutes of Evidence and Appendix. 414 p., f. cap. London, 1882. *Miss Greenhow.*

Stock, *C. Haden.* Shoring and Underpinning. 54 p., 8vo. London, 1889. *Purchased.*

Suisse. Statistique de la, 84e livraison, les Résultats du recensement Fédéral du 1er Décembre, 1888. 287 p., 4to. Berne, 1892. *Dr. Guillaume.*

Sutcliffe, *J. D.* Warming and Ventilation of Public Buildings with or without Motive Power. A Paper read before the Philosophical Society of Glasgow, 18th January, 1892. 16 p., 8vo. *W. Whitaker.*

Sykes, *Dr. J. F. J.* Public Health Problems. 370 p., 8vo. London, 1892. (Contemporary Science Series.) *W. Scott, Limited.*

Tarn, *E. Wyndham.* The Science of Building. 216 p., 16mo. London, 1890. *Purchased.*

Thackrah, *C. Turner.* The effects of Arts, Trades, and Professions and of Civic States and Habits of Living on Health and Longevity. 238 p., 8vo. London, 1832. *Miss Greenhow.*

Thompson, *Sir Henry.* Food and Feeding. 222 p., 8vo. London, 1891. *The Author.*

Thorne, *Thorne Dr.* Diphtheria, its Natural History and Prevention. 266 p., 8vo. London, 1891. *The Author.*

Thornton, *B.* The Comparative Climatology of London and the Chief English Health Resorts. 15 p., 8vo. London, 1891. *The Author.*

Tredgold, *J.* Elementary Principles of Carpentry. 527 p. (Plates), 8vo. London, 1890. *Purchased.*

Trélat, *M. Émile.* Théorie du Chauffage des habitations. 11 p., 8vo. Paris, 1892. *The Author.*

Vaccination. Papers relating to the History and Practice. 188 p., 4to. London, 1857. *Miss Greenhow.*

——— Papers relating to the History and Practice of, issued by the General Board of Health. 188 p., 4to. London, 1857. *Miss Greenhow.*

Vaccination Returns. Norwich Public Vaccination Station. 69 p., f. cap. London, 1882. *Miss Greenhow.*

Vacher, *Francis.* Defects in Plumbing and Drainage Work. 83 p., 8vo. London, 1889. *The Author.*

Wakefield. Reports of Course of Lectures to Sanitary Officers. 190 p., 8vo. Wakefield, 1892. *Purchased.*

Waring, *Col. G. E., Jun.* The Sewerage of two New Hampshire Towns—Keene and Laconia. 14 p., 8vo. Concord, 1892. *The Author.*

——— Sewage Disposal of Wayne, Pa. 4 p., f. cap. Reprint from the *American Architect*, 2nd July, 1892. *The Author.*

——— Sewage Disposal for Isolated Houses and large Institutions. 7 p., f. cap. Reprint from the *American Architect*, April, 1892. *The Author.*

Warner, *Dr. Francis.* Abstracts of the Milroy Lectures, on an inquiry as to the physical and mental condition of school children. 14 p., 8vo. London, 1892. *The Author.*

Wharam, *R. M.* Hints on Sanitary Fittings and their Application. 31 p., 8vo. London, 1891. *The Author.*

Whitaker, *W.* Report on the Best Source for a Water Supply for the Town of King's Lynn. 8 p. 8vo. King's Lynn, 1892. *The Author.*

Whitelegge, *Dr. B. A.* Hygiene and Public Health. 531 p., 8vo. London, 1890. *The Author.*

Wilson, *Dr. G.* Handbook of Hygiene. 7th Edit., 751 p., 8vo. London, 1892.

PERIODICALS.

Weekly.

British Medical Journal.
Builder.
Contract Journal.
County Council Times.
Illustrated Carpenter and Builder
Industries.
Invention.
Journal d'Hygiène.
Journal Society of Arts.
Local Government Chronicle.
Local Government Journal.
Nursing Record.
Surveyor.

Fortnightly.

Sanitary Record.

Monthly.

Engineering Review.
Health Record, Dublin.
Hygiene.
Ironmonger.
Journal of the Royal Institute of British Architects.
Meteorological Record.
Plumber and Decorator.
Practitioner.
Public Health.
Sanitarian.
Sei-i-Kwai Medical Journal.

Quarterly.

Deutsche Vierteljahrsschrift für öffentliche Gesundheitpflege.

LECTURES & MEETINGS FOR 1893.

JANUARY.

2 M. Exhibition Committee.
7 S. Lecture to Sanitary Officers, King's Lynn, 2 p.m.
11 W. Finance Committee, 4 p.m.; Council, 5 p.m.
14 S. Lecture to Sanitary Officers, King's Lynn, 2 p.m.
19 Th. Examination Committee.
21 S. Lecture to Sanitary Officers, King's Lynn, at 2 p.m.
23 M. Museum Committee.
27 F. }
28 S. } Examination, Worcester.
28 S. Lecture to Sanitary Officers, King's Lynn, 2 p.m.
31 Tu. Lecture to Sanitary Officers, London, 8 p.m.

FEBRUARY.

3 F. Lecture to Sanitary Officers, London, 8 p.m.
4 S. Lecture to Sanitary Officers, King's Lynn, 2 p.m.
6 M. Exhibition Committee.
7 Tu. Lecture to Sanitary Officers, London, 8 p.m.
8 W. Finance Committee, 4 p.m.; Council, 5 p.m.; Sessional Meeting at 8 p.m.
10 F. Lecture to Sanitary Officers, London, 8 p.m.
11 S. Lecture to Sanitary Officers, King's Lynn, 2 p.m.
11 S. Visit of the Students to South Norwood Irrigation Farm, 3 p.m.
14 Tu. Lecture to Sanitary Officers, London, 8 p.m.
15 W. Visit of the Students to an Inspection in the Parish of Chelsea, 2 p.m.
17 F. Lecture to Sanitary Officers, London, 8 p.m.
18 S. Lecture to Sanitary Officers, King's Lynn, 2 p.m.
18 S. Visit of the Students to Express Dairy Company's Establishment at Heath Street, Hampstead, 3 p.m.
21 Tu. Lecture to Sanitary Officers, London, 8 p.m.

FEBRUARY—(*Continued*).

22 W. Visit of the Students to an Inspection in the Parish of St. George's, Hanover Sq., 2 p.m.
24 F. Lecture to Sanitary Officers, London, 8 p.m.
25 S. Lecture to Sanitary Officers, King's Lynn, 2 p m.
25 S. Visit of the Students to East London Water Works, Lea Bridge. 3 p.m.
25 S. Lecture to Sanitary Officers, Exeter, 3 p.m.
27 M. Museum Committee.
28 Tu. Lecture to Sanitary Officers, London, 8 p.m.

MARCH.

1 W. Visit of the Students to an Inspection in the Parish of Chelsea, 2 p.m.
3 F. Lecture to Sanitary Officers, London, 8 p.m.
4 S. Lecture to Sanitary Officers, King's Lynn, 2 p.m.
4 S. Lecture to Sanitary Officers, Exeter, 3 p.m.
4 S. Visit of the Students to Leyton Sewage Works, 3 p.m.
6 M. Exhibition Committee.
7 Tu. Lecture to Ladies, 3 p.m.
7 Tu. Lecture to Sanitary Officers, London, 8 p.m.
8 W. Finance Committee, 3.30 p.m.
8 W. Council Meeting, 5 p.m.
8 W. Sessional Meeting, 8 p.m.
10 F. Lecture to Ladies, 3 p.m.
10 F. Lecture to Sanitary Officers, London, 8 p.m.
11 S. Visit of the Students to the Shone System of Drainage, Houses of Parliament, 11.45 a.m.
11 S. Lecture to Sanitary Officers, King's Lynn, 2 p.m.
11 S. Lecture to Sanitary Officers, Exeter, 3 p.m.
14 Tu. Lecture to Ladies, 3 p.m.
14 Tu. Lecture to Sanitary Officers, London, 8 p.m.
15 W. Visit of the Students to the Disinfecting Station, Apparatus, &c., St. Pancras, 3.30 p.m.

MARCH—(*Continued*).

17 F. Lecture to Ladies, 3 p.m.
17 F. Lecture to Sanitary Officers, London, 8 p.m.
18 S. Lecture to Sanitary Officers, King's Lynn, 2 p.m.
18 S. Lecture to Sanitary Officers, Exeter, 3 p.m.
18 S. Lecture to Sanitary Officers, Dublin, 3 p.m.
21 Tu. Lecture to Sanitary Officers, London, 8 p.m.
22 W. Visit of the Students to an Inspection in the Parish of St. George's, Hanover Sq., 2 p.m.
24 F. Lecture to Sanitary Officers, London, 8 p.m.
25 S. Lecture to Sanitary Officers, King's Lynn, 2 p.m.
25 S. Lecture to Sanitary Officers, Exeter, 3 p.m.
25 S. Lecture to Sanitary Officers, Dublin, 3 p.m.
25 S. Visit of the Students to the London Subways, 3 p.m.
27 M. Museum Committee.
28 Tu. Lecture to Sanitary Officers, London, 8 p.m.
29 W. Visit of the Students to the Disinfecting Station, Apparatus, &c., St. Pancras, 3.30 p.m.

APRIL.

1 S Lecture to Sanitary Officers, Exeter, 3 p.m.
1 S. Lecture to Sanitary Officers, Dublin, 3 p.m.
1 S. Visit of the Students to the Express Dairy Company's Farm, Finchley.
3 M. Exhibition Committee.
7 F. Examination Committee.
8 S. Lecture to Sanitary Officers, Exeter, 3 p.m.
8 S. Lecture to Sanitary Officers, Dublin, 3 p.m.
12 W. Finance Committee, 4 p.m.; Council, 5 p.m.; Sessional Meeting, 8 p.m.
14 F. Examination, London.
15 S. Examination, London.
15 S. Lecture to Sanitary Officers, Exeter, 3 p.m.
15 S. Lecture to Sanitary Officers, Dublin, 3 p.m.
22 S. Lecture to Sanitary Officers, Exeter, 3 p.m.
22 S. Lecture to Sanitary Officers, Dublin, 3 p.m.
24 M. Museum Committee.
28 F. Examination, King's Lynn.

APRIL—(*Continued*).

29 S. Examination, King's Lynn.
29 S. Lecture to Sanitary Officers, Exeter, 3 p.m.
29 S. Lecture to Sanitary Officers, Dublin, 3 p.m.

MAY.

1 M. Exhibition Committee.
6 S. Lecture to Sanitary Officers, Exeter, 3 p.m.
6 S. Lecture to Sanitary Officers, Dublin, 3 p.m.
10 W. Finance Committee, 4 p.m.; Council, 5 p.m.
13 S. Lecture to Sanitary Officers, Exeter, 3 p.m.
13 S. Lecture to Sanitary Officers, Dublin, 3 p.m.
19 F. Examination Committee.
20 S. Lecture to Sanitary Officers, Dublin, 3 p.m.
22 M. Museum Committee.
26 F. Examination, Exeter.
27 S. Examination, Exeter.
27 S. Lecture to Sanitary Officers, Dublin, 3 p.m.

JUNE.

3 S. Lecture to Sanitary Officers, Dublin, 3 p.m.
5 M. Exhibition Committee.
9 F. Examination for Surveyors, London.
10 S. Examination for Surveyors, London.
10 S. Lecture to Sanitary Officers, Dublin, 3 p.m.
14 W. Finance Committee, 4 p.m.; Council, 5 p.m.
23 F. Examination, Dublin.
24 S. Examination, Dublin.
26 M. Museum Committee.
30 F. Examination Committee.

JULY.

3 M. Exhibition Committee.
7 F. Examination, Leeds.
8 S Examination, Leeds.
12 W. Finance Committee, 4 p.m.; Council, 5 p.m.
17 M. Congress Committee.
24 M. Museum Committee.
28 F. Examination, Cardiff.
29 S. Examination, Cardiff.

OCTOBER.

2 M. Exhibition Committee.
3 Tu. Lecture to Sanitary Officers, London, 8 p.m.

OCTOBER—(*Continued*).

6 F. Lecture to Sanitary Officers, London, 8 p.m.
10 Tu. Lecture to Sanitary Officers, London, 8 p.m.
11 W. Finance Committee, 4 p.m.; Council, 5 p.m.
13 F. Lecture to Sanitary Officers, London, 8 p.m.
16 M. Congress Committee.
17 Tu. Lecture to Sanitary Officers, London, 8 p.m.
20 F. Lecture to Sanitary Officers, London, 8 p.m.
23 M. Museum Committee.
24 Tu. Lecture to Sanitary Officers, London. 8 p.m.
27 F. Lecture to Sanitary Officers, London, 8 p.m.
31 Tu. Lecture to Sanitary Officers, London, 8 p.m.

NOVEMBER.

3 F. Examination Committee.
3 F. Lecture to Sanitary Officers, London, 8 p.m.
6 M. Exhibition Committee.
7 Tu. Lecture to Sanitary Officers, London, 8 p.m.

NOVEMBER—(*Continued*).

8 W. Finance Committee, 4 p.m.; Council, 5 p.m.
10 F. Examination, Newcastle-on-Tyne.
10 F. Lecture to Sanitary Officers, London, 8 p.m.
11 S. Examination, Newcastle-on-Tyne.
14 Tu. Lecture to Sanitary Officers, London, 8 p.m.
17 F. Lecture to Sanitary Officers, London, 8 p.m.
21 Tu. Lecture to Sanitary Officers, London, 8 p.m.
24 F. Examination Committee.
24 F. Lecture to Sanitary Officers, London, 8 p.m.
27 M. Museum Committee.
28 Tu. Lecture to Sanitary Officers, London, 8 p.m.

DECEMBER.

1 F. Examination, London.
2 S. Examination, London.
4 M. Exhibition Committee.
13 W. Finance Committee, 4 p.m.; Council, 5 p.m.
15 F. Manchester Examination.
16 S. Manchester Examination.
18 M. Museum Committee.

LIST OF HON. FELLOWS, FELLOWS, MEMBERS, AND ASSOCIATES.

Additions and Corrections to December 31st, 1892.

HON. FELLOWS, 26; FELLOWS, 146;
MEMBERS, 510; ASSOCIATES, 598.—TOTAL, 1280.

HONORARY FELLOWS.

Reg. No.	Date of Election.	AUSTRIA-HUNGARY.
15	1890. June.	VON GRUBER, Prof. Franz Ritter, 1, *Tiefer Graben* 3, *Vienna.*
16	1890. June.	FODOR, Dr., *Professor of Hygiene, Buda-Pesth.*
		BELGIUM.
29	1890. June.	PUTZEYS, Dr. Felix, *Professor of Hygiene at the University of Liège.*
		EGYPT.
30	1890. Dec.	GREENE, Dr. H. R., Pasha, *late Chief of the Sanitary Department, Cairo.*
		FRANCE.
31	1892. Oct.	BECHMANN, M., *Ingénieur en Chef des Ponts et Chaussées; Directeur des Service d'Assainissement de Paris;* 9, *Place de l'Hôtel-de-Ville, Paris.*
2	1890. June.	BROUARDEL, Dr. Paul, *Prof. and Dean of the Faculty of Medicine, Paris.*
3	1890. June.	CORNIL, Dr. V., *Senator*, 19, *Rue St. Guillaume, Paris.*
4	1890. June.	PASTEUR, Prof. Louis, 25, *Rue Dutot, Paris.*
6	1890. June.	DE PIÉTRA SANTA, Dr. Prosper, *Hon Sec. of the French Society of Hygiene*, 30, *Rue du Dragon, Paris.*
7	1890. June.	VALLIN, Dr. Emile, *Professor of Hygiene, Director of the School of the Military Sanitary Service, Lyons.*
8	1890. June.	MARIÈ DAVY, Dr. H., *Hon. President of the French Society of Hygiene.*
		GERMANY.
9	1890. June.	HOBRECHT, Dr., *Engineer, Berlin.*
10	1890. June.	VON HOFMANN, Prof. A. W., *Professor of Chemistry, Berlin.*
11	1890. June.	KOCH, Dr., *Director of the Hygienic Institute, Berlin.*
12	1890. June.	PETTENKOFER, Dr., *Professor of Hygiene at the University of Munich.*
13	1890. June.	ROTH, Prof. Dr. W., *Surgeon-General*, 6, *Kaizer Wilhelm Platz, Dresden.*
14	1890. June.	VIRCHOW, Dr. Rudolph, *Professor of Pathology, Berlin.*

Reg. No.	Date of Election.	

HOLLAND.

28 1890. June. DE MEYER, Dr. van Overbeek, *Professor of Hygiene at the State University of Utrecht, Netherlands.*

ITALY.

18 1890. June. BETOCCHI, Com^re. Alessandro, Prof., *Civil Engineer, Ministry of Public Works, Rome.*

20 1890. June. PACCHIOTTI, Dr. Giacinto, *Professor of Hygiene, Turin.*

ROUMANIA.

22 1890. June. FELIX, Dr. J., *Professor of Hygiene, Bucharest.*

RUSSIA.

21 1890. June. SUZOR, Comte de, *Architect-in-chief, Ligue de Cadets* 21, *St. Petersburgh.*

SWITZERLAND.

23 1890. June. GUILLAUME, Dr., *Director of the Federal Bureau of Statistics, Berne.*

TURKEY.

24 1890. June. ZOËROS, A., Pasha, *Professor at the School of Medicine, Director of the Bacteriological Institute, Secretary-General of the Administration of Public Medicine and Hygiene, Constantinople.*

UNITED STATES.

25 1890. June. BILLINGS, Dr. John S., *Washington, D.C.*

27 1890. June. WALCOTT, Dr. Henry P., *Cambridge, Massachusetts.*

FELLOWS (FELLOW SAN. INST.)

† Marked thus have passed the Examination of the Institute for Local Surveyors.

19 1889. Dec. ABEL, SIR Frederick, BART., K.C.B., F.R.S., *Imperial Institute, Imperial Institute Road, S.W.*, (40, *Cadogan Place, S.W.*)

561 1891. Dec. ACLAND, SIR Henry W., K.C.B., M.D., D.C.L., F.R.S., *Broad Street, Oxford.*

15 1888. Oct. ADAMS, G. E. D'Arcy, M.D., D.P.H.CAMB., F.G.S., 1, *Clifton Gardens, Maida Vale, W.*

16 1888. Oct. ALBANY, H.R.H. THE DUCHESS OF, *Claremont, Esher.*

316 1888 Oct. ANGELL, Lewis, M.INST.C.E., F.K.C.LOND., *Town Hall, Stratford, E.*

27 1890. Feb. ANNINGSON, Bushell, M.A., M.D., *Cambridge.*

18 1888. Oct. ARCHER, John A., 79, *Larkhall Rise, S.W.*

Reg. No.	Date of Election.	
28	1889. Dec.	ARMISTEAD, William, M.B., M.O.H., *Shelford, Cambridge.*
45	1889. Dec.	BARRY, Charles, F.S.A., 1, *Victoria Street, S.W.*
366	1888. Dec.	BASS, Hamar Alfred, M.P., *Burton-on-Trent.*
32	1888. Oct.	BELL, MAJOR C. W., J.P., D.L., *Yewhurst, East Grinstead, Sussex.*
33	1888. Oct.	BIRCH, R. W. Peregrine, M.INST.C.E., 5, *Queen Anne's Gate, S.W.*
59	1889. Dec.	BLOMFIELD, SIR A. W., M.A., F.R.I.B.A., 6, *Montague Place, W.*
34	1888. Oct.	BLYTH, A. Wynter, M.R.C.S., L.S.A., *Court House, Marylebone.*
61	1888. Oct.	†BOULNOIS, H. Percy, M.INST.C.E., *City Engineer, Liverpool.*
378	1890. Jan.	BOWMAN, SIR William, BART., M.D., LL.D., F.R.S., 5, *Clifford Street, Bond Street, W.*
67	1890. Jan.	BRETT, A. T., M.D., M.O.H., *Watford House, Watford.*
35	1888. Oct.	BRIGHTEN, W. G., 108, *Fenchurch Street, E.C.*
328	1889. Dec.	BROCK, J. H. E., M.D., B.SC.LOND., 115, *Adelaide Road, South Hampstead.*
36	1888. Oct.	BROWN, Harry, *The Elms, Worsley Road, Hampstead, N.W.*
37	1888. Oct.	BROWNING, Benjamin, L.R.C.P., M.R.C.S., D.P.H.CAMB., M.O.H., 16, *Royal Terrace, Weymouth.*
38	1888. Oct.	BURBERY, J. Stone, *Trent House, West Cowes, I. of W.*
39	1888. Oct.	BURDETT, Henry C., F.S.S., F.L.S., *The Lodge, Porchester Square, W.*
40	1888. Oct.	BURGESS, Peter, M.A., M.B., *Driffield, Yorkshire.*
71	1888. Oct.	CAMBRIDGE, H.R.H. THE DUKE OF, K.G., *Gloucester House, Park Lane, W.*
317	1888. Oct.	CAREW, R. R., *Carpenders, Watford, Herts.*
73	1888. Oct.	CARTER, R. Brudenell, F.R.C.S., 27, *Queen Anne Street, Cavendish Square, W.*
13	1888. Aug.	CASSAL, Charles E., F.I.C., F.C.S., *Town Hall, Kensington, W.*, (*Vestry Hall, Mount Street, Grosvenor Square, W.*), (*Brenne House, Wandsworth Common, S.W.*).
80	1890. May.	CATES, Arthur, F.R.I.B.A., 7, *Whitehall Yard, S.W.*
74	1888. Oct.	CLARK, F. Le Gros, F.R.S., *The Thorns, Sevenoaks, Kent.*
318	1888. Oct.	COLLINS, H. H., F.R.I.B.A., 61, *Old Broad Street, E.C.*, (5, *Randolph Road, W.*).
87	1889. Dec.	COLLINS, Wm. J., M.D., B.SC.LOND., D.P.H., 1, *Albert Terrace, Regent's Park, N.W.*
75	1888. Oct.	COLMAN, J. J., M.P., *Carrow House, Norwich.*
7	1888. Aug.	CORFIELD, PROF. W. H., M.A., M.D.OXON., F.R.C.P. LOND., 19, *Savile Row, W.*
76	1888. Oct.	CRAWFORD, SIR Thomas, M.D., K.C.B., 5, *St. John's Park, Blackheath.*
77	1888. Oct.	CUTLER, Thomas William, F.R.I.B.A., 5, *Queen Square, Bloomsbury.*

Reg. No.	Date of Election.	
101	1888. Oct.	Davey, Alexander George, M.D., L.R.C.P., M.R.C.S., 9, *Belvedere Street, Ryde, Isle of Wight.*
549	1891. Mar.	de Courcy Meade, Thomas, M.INST.C.E., 1, *Park Villas, The Park, Highgate, N.*
102	1888. Oct.	Derby, Rt. Hon. Earl of, D.C.L., LL.D., F.R.S., 33, *St. James' Square, S.W.*
103	1888. Oct.	Doulton, Sir Henry, *Lambeth, S.W.*
113	1890. Feb.	Dowson, A., 3, *Gt. Queen Street, Westminster.*
319	1888. Oct.	Doyle, Patrick, C.E., F.G.S., *Indian Engineering, Spence's Hotel, Calcutta.*
11	1888. Aug.	Dudfield, T. Orme, M.D., L.R.C.P., M.R.C.S., 14, *Ashburn Place, Cromwell Road, S.W.*
104	1888. Oct.	Dyke, T. J., F.R.C.S., *The Hollies, Merthyr Tydfil.*
114	1888. Oct.	Eaton, John, M.D., *Montreal House, Cleator Moor, Cumberland.*
115	1888. Oct.	Ellis, W. Horton, F.R.MET.SOC.
384	1890. Dec.	Ewart, Joseph, M.D., F.R.C.P., J.P., *Montpelier House, Montpelier Terrace, Brighton.*
119	1888. Oct.	Fayrer, Sir Joseph, K.C.S.I., M.D., F.R.C.P., F.R.C.S., LL.D., F.R.S., 53, *Wimpole Street, W.*
120	1888. Oct.	Field, Basil, B.A., 36, *Lincoln's Inn Fields, W.C.*
10	1888. Aug.	Field, Rogers, B.A., M.INST.C.E., 7, *Victoria Street, Westminster, S.W.*
121	1888. Oct.	Flower, Major Lamorock, *Lee Conservancy Board,* 12, *Finsbury Circus, E.C.* (48, *Holland Road, W.*).
355	1888. Nov.	Fortescue, Rt. Hon. Earl, 48, *Grosvenor Gardens, S.W.*, (*Castle Hill, South Molton, Devon*).
3	1888. Aug.	Galton, Sir Douglas, K.C.B., D.C.L., LL.D., F.R.S., 12, *Chester Street, Grosvenor Place, S.W.*
132	1888. Oct.	Gowers, William Richard, M.B., 50, *Queen Anne St., W.*
134	1888. Oct.	Grimshaw, Thomas Wrigley, M.D., *Priorsland, Carrickmines, Dublin.*
141	1888. Oct.	Harker, J., M.D., J.P., *Hazel Grove, Carnforth, Lanc.*
410	1890. May.	Harris, Alfred E., L.R.C.P., L.R.C.S., M.O.H., *Vestry Hall, Upper Islington.*
142	1888. Oct.	Harris, Thomas, F.R.I.B.A., 6, *Southampton Street, Bloomsbury Square, W.C.*
150	1890. Jan.	Harrison, C., M.D., D.P.H.CAMB., *Newland, Lincoln.*
143	1888. Oct.	Hart, Ernest, 38, *Wimpole Street, W.*
144	1888. Oct.	Haviland, A., M.R.C.S., *Douglas, Isle of Man.*
388	1890. June.	Hehir, Patrick, M.D., F.R.C.S., D.P.H., *Hyderabad, Deccan, India.*
154	1890. Jan.	Hill, Alfred, M.D., M.R.C.S., L.S.A., *The Council House, Birmingham.*
367	1888. Dec.	Hime, Thomas Whiteside, A.B., M.B., L.R.C.S., 54, *Horton Road, Bradford.*
146	1888. Oct.	Hodson, George, M.INST.C.E., F.G.S., *Abbey Buildings, Princes Street, Westminster,* (*Loughborough*).

Reg. No. Date of Election.

160 1889. Dec. HOPE, E. W., M.D., D.P.H., *Municipal Offices, Liverpool.*

147 1888. Oct. HUMPHRY, SIR G. M., M.D., F.R.S., *Cambridge.*

164 1889. Dec. HUNTER, SIR William Guyer, K.C.M.G., M.D., F.R.C.P., 21, *Norfolk Crescent, Hyde Park, W.*

165 1890. Jan. ILIFFE, William, M.R.C.S., 41, *Osmaston Street, Derby.*

166 1888. Oct. JONES, LIEUT.-COL. A. S., V.C., ASSOC.M.INST.C.E., *Culverside, Carshalton, Surrey.*

6 1888. Aug. JUDGE, Mark H., A.R.I.B.A., 15, *Connaught Square, W.*

167 1888. Oct. KELLY, Charles, M.D., F.R.C.P., *Ellesmere, Gratwicke Road, Worthing.*

368 1888. Dec. KINGDON, J. A., *Grocer's Hall, E.C.*

169 1888. Oct. LATHAM, Baldwin, M.INST.C.E., F.R.MET.SOC., F.G.S., F.S.S., 13, *Victoria Street, S.W.*, (*Duppas House, Croydon*).

170 1888. Oct. LAW, Henry, M.INST.C.E., F.R.MET.SOC., 17, *Victoria Street, S.W.*, (245, *Vauxhall Bridge Road*).

176 1889. Dec. LAWRENCE, SIR Trevor, BART., M.P., 57, *Prince's Gate, S.W.*

171 1888. Oct. LAWSON, INSPECTOR-GENERAL R., LL.D., F.S.S., 20, *Lansdowne Road, Notting Hill.*

172 1888. Oct. LEAF, Charles J., F.L.S., F.S.A., 6, *Sussex Place, Regent's Park, N.W.*

370 1888. Dec. LEAF, W., LITT.DOC., 6, *Sussex Place, Regent's Park, N.W.*

5 1888. Aug. LEWIS, PROF. T. Hayter, F.S.A., F.R.I.B.A., 12, *Kensington Gardens Square, S.W.*

173 1888. Oct. LIVESEY, J., M.INST.C.E., 2, *Victoria Mansions, Victoria Street, Westminster, S.W.*

369 1888. Dec. LONGSTAFF, G. B., M.D., M.A., D.P.H., *Southfield Grange, Wandsworth, S.W.*

371 1888. Dec. LUBBOCK, RT. HON. SIR John, BART., M.P., D.C.L., F.R.S., *Lombard Street, E.C.*

186 1888. Oct. MACKEY, John Alexander Dixie, B.A.OXON., 1, *Westbourne Terrace, W.*

187 1888. Oct. MANSERGH, James, M.INST.C.E., 5, *Victoria Street, S.W.*

188 1888. Oct. MEATH, RT. HON. EARL OF, 83, *Lancaster Gate, Hyde Park.*

202 1892. Oct. MIDDLETON, Reginald Empson, M.INST.C.E., F.S.I., 17, *Victoria Street, S.W.*

211 1890. Jan. MURPHY, Shirley F., M.R.C.S., 41, *Queen Anne Street, W.*

504 1890. June. NEWSHOLME, Arthur, M.D., D.P.H., M.O.H., *Town Hall, Brighton*, (15, *College Road, Brighton*).

373 1888. Dec. NIGHTINGALE, Miss F., 10, *South Street, Grosvenor Square, W.*

397 1890. May. NORTH, Samuel W., M.R.C.S., F.G.S., M.O.H., *Micklegate, York.*

1 1888. Aug. NORTHUMBERLAND, HIS GRACE THE DUKE OF, K.G., D.C.L., LL.D., 2, *Grosvenor Place, S.W.*

Reg. No.	Date of Election.	
551	1890. Nov.	NOTTER, PROF. J. Lane, M.A., M.D., D.P.H., *West Cliffe, Woolston, Southampton.*
221	1888. Oct.	OHREN, Magnus, ASSOC.M.INST.C.E., F.C.S., *Lower Sydenham.*
322	1888. Oct.	OLLARD, J. F., *The Manor House, North Runcton, King's Lynn.*
222	1888. Oct.	OLLARD, William Ludlam, *Musticott House, Walsoken, Wisbeach, Norfolk.*
229	1889. Nov.	PAGET, Charles Edward, M.R.C.S., D.P.H., M.O.H., *Town Hall, Salford.*
223	1888. Oct.	PAGET, J., J.P., *Stuffynwood, Mansfield.*
12	1888. Aug.	PARKES, Charles Henry, *Netherfield, Weybridge.*
224	1888. Oct.	PARKES, Louis Coltman, M.D., M.R.C.S., D.P.H., 61, *Cadogan Square, S.W.*
225	1888. Oct.	PEGGS, J. Wallace, ASSOC.M.INST.C.E., 9, *Welbeck Mansions, Cadogan Terrace, S.W.*, (21, *Queen Anne's Gate, S.W.*).
226	1888. Oct.	PLUMBE, Rowland, F.R.I.B.A., 13, *Fitzroy Square, W.*
14	1888. Aug.	POORE, George Vivian, M.D., F.R.C.P., 30, *Wimpole Street, W.*
401	1890. Jan.	POWELL, SIR Francis Sharp, BART., M.P., 1, *Cambridge Square, W.*, (*Horton Old Hall, Bradford*).
227	1888. Oct.	PRITCHARD, E., M.INST.C.E., F.G.S., 1, *Victoria Street, S.W.*, (37, *Waterloo Street, Birmingham*).
244	1888. Oct.	RAWLINSON, SIR Robert, K.C.B., M.INST.C.E., 11, *The Boltons, Brompton, S.W.*
250	1890. Feb.	REDWOOD, T. Hall, M.D., *The Lawn, Rhymney.*
608	1891. Oct.	REID, George, M.D., D.P.H., *County Medical Officer of Health, Stafford.*
323	1888. Oct.	REYNOLDS, PROF. J. Russell, M.D., F.R.C.P., F.R.S., 38, *Grosvenor Street, W.*
356	1888. Nov.	RICHARDSON, SIR Benjamin Ward, M.D., LL.D., F.R.S., 25, *Manchester Square, W.*
245	1888. Oct.	RICHARDSON, J., M.INST.C.E., *Methley Park, Leeds.*
252	1890. Jan.	RIPON, MOST HON. MARQUESS OF, K.G., D.C.L., F.R.S., 9, *Chelsea Embankment, S.W.*
246	1888. Oct.	ROBINS, Edward Cookworthy, F.S.A., F.R.I.B.A., 46, *Berners Street, W.*
247	1888. Oct.	ROBINSON, PROF. Henry, M.INST.C.E., 13, *Victoria Street, S.W.*, (54, *Boundary Road, N.W.*).
620	1892. Oct.	ROCHE, Anthony, M.R.C.P.I., L.R.C.S.I., 72, *Harcourt Street, Dublin, Professor of Hygiene and also of Medical Jurisprudence in the Catholic University, Examiner in Sanitary Science, Royal University, Dublin.*
248	1888. Oct.	RUSSELL, HON. F. A. Rollo., F.R.MET.SOC., *Dunrozel, Haslemere.*
324	1888. Oct.	RUSSELL, James A., M.A., F.R.C.P.EDIN., M.B., B.SC., F.R.S.E., *Woodville, Canaan Lane, Edinburgh.*
256	1890. Jan.	RUSSELL, J. B., M.D., LL.D., M.O.H., *Glasgow.*

Reg. No.	Date of Election.	
417	1889. Jan.	SALT, Thomas, M.P., 85, *St. George's Square, S.W.*
265	1889. Dec.	SEATON, Edward Cox, M.D., F.R.C.S., *The Limes*, 56, *North Side, Clapham Common.*
325	1888. Oct.	SHAW, George, 20, *King Edward Street, Newgate Street, E.C.*
374	1888. Dec.	SIEVEKING, SIR E. H., M.D., 17. *Manchester Sq., W.*
347	1889. Nov.	SMITH, James, Osborne, A.R.I.B.A., 34, *Southampton Street, Strand, W.C.*, (65, *Frithfield Gardens, Uxbridge Road, W.*).
492	1892. Oct.	SMITH, William Howard, ASSOC.M.INST.C.E., *City Engineer and Surveyor, Carlisle.*
257	1888. Oct.	SMITH, PROF. William Robert, M.D., F.R.S.E., D.SC., *Barrister-at-Law*, 74, *Great Russell Street, W.C.*, (*Plumstead, Kent*).
258	1888. Oct.	SNELL, H. Saxon, F.R.I.B.A., 22, *Southampton Buildings, W.C.*, (*Lynden Lodge, Elmfield Rd., Bromley, Kent*).
460	1889. Mar.	STEPHENS, Henry C., M.P., *Avenue House, Finchley.*
260	1888. Oct.	STRONG, Henry John, M.D., *Colonade House, The Steyne, Worthing.*
261	1888. Oct.	SYKES, J. F. J., M.D., B.SC., 40, *Camden Square, N.W.*
4	1888. Aug.	SYMONS, G. J., F.R.S., 62, *Camden Square, N.W.*
285	1889. Dec.	TAYLOR, J. Stopford, M.D., M.O.H., 6, *Grove Park, Liverpool.*
280	1888. Oct.	TEMPLE, RIGHT REV. Frederick, D.D., LORD BISHOP OF LONDON, *The Palace, Fulham.*
291	1889. Dec.	THOMPSON, SIR Henry, M.B., 35, *Wimpole Street, W.*
282	1888. Oct.	THORNE, R. Thorne, C.B., M.B., 45, *Inverness Ter., W.*
283	1888. Oct.	TURNER, Ernest, F.R.I.B.A., 246, *Regent Street, W.*
8	1888. Aug.	TWINING, Thomas, *Perryn House, Twickenham.*
450	1889. Feb.	TYNDALL, PROF. John, LL.D., D.C.L., F.R.S., *Hind Head House, Shotter Mill, near Petersfield.*
413	1891. Nov.	VACHER, Francis, F.R.C.S., *Birkenhead.*
301	1889. Dec.	WALFORD, Edward, M.D., D.P.H.CAMB., M.R.C.S., M.O.H., *Town Hall, Cardiff.*
295	1888. Oct.	WARING, COL. G. E., Jun., M.INST.C.E., *Newport, Rhode Island, U.S. America.*
296	1888. Oct.	WATERHOUSE, Alfred, R.A., 20, *New Cavendish Street, W.*
2	1888. Aug.	WESTMINSTER, HIS GRACE THE DUKE OF, K.G., *Grosvenor House, W.*
297	1888. Oct.	WHITELEGGE, Benjamin Arthur, M.D., B.SC., D.P.H.CAMB., *St. John's, Wakefield.*
298	1888. Oct.	WILLIAMS, Dawson, M.D., 25, *Old Burlington St., W.*
299	1888. Oct.	WILSON, George, M.A., M.D., F.R.S.E., 7, *Avon Place Warwick.*
418	1889. Jan.	WIX, H. A., 3, *King's Bench Walk, Temple, E.C.*

ORDINARY MEMBERS (Mem. San. Inst.)

† Marked thus have passed the Examination of the Institute for Local Surveyors.

‡ Marked thus have passed the Examination of the Institute for Inspectors of Nuisances.

Reg. No.	Date of Election.	
590	1890. May.	Adams, Frederick Edward, M.D., D.P.H., *Town Hall, Bolton.*
461	1889. Mar.	Adams, James, M.D., M.O.H., *Springwell, Barnes, Surrey.*
665	1891. Dec.	Adams, Prof. Henry, M.INST.C.E., F.S.I., 60, *Queen Victoria Street, E.C.*
465	1889. Mar.	Adkins, George, L.R.C.P.LOND., D.P.H., M.O.H., *Yealmpton, Plympton, Devon.*
375	1888. Dec.	Airy, Hubert, M.A., M.D., *Local Government Board, S.W.*
451	1889. Feb.	Aldwinckle, Thomas William, F.R.I.B.A., 1, *Victoria Street, S.W.*
352	1888. Oct.	Alexander, W. C., *Aubrey House, Campden Hill, W.*
510	1889. Apr.	Allfrey, Charles Henry, M.D., F.R.C.S., D.P.H., *Plas Newydd, Princes Road, St. Leonards-on-Sea.*
21	1888. Oct.	Ames, H. St. Vincent, M.A., *Cote House, Westbury-on-Trym, Bristol.*
22	1888. Oct.	Anderson, Geo., C.E., 35*a*, *Great George Street, Westminster, S.W.*
440	1889. Jan.	†Anderson, John Reid, *The Cottage, Gibson's Hill, Norwood, S.E.*
611	1890. Dec.	Anderson, John, ASSOC.M.INST.C.E., *Town Hall, Montrose, N.B.*
23	1888. Oct.	Andresen, August F., *Priory Cottage, Mill Lane, West Hampstead.*
24	1888. Oct.	Andrew, Capt. C. W., 286, *Kennington Park Road, S.E.*
455	1889. Mar.	Andrews, G. R., *Surveyor, Johannesburg, South Africa.*
25	1888. Oct.	Andrews, Jonathan, 10A, *Mount Street, Berkeley Square, W.*
26	1888. Oct.	†Angell, John A., ASSOC.M.INST.C.E., *Borough Engineers' Office, West Ham, E.*
555	1889. Nov.	Anson, Frederick Henry, M.A., ASSOC.M.INST.C.E., 15, *Dean's Yard, Westminster, S.W.*
752	1892. Dec.	Argles, Frank, M.R.C.P., M.O.H., *Wanstead, Essex.*
646	1891. Oct.	Armstrong, Henry E., D.HYG., M.R.C.S., L.S.A., M.O.H., *The Health Department, Town Hall, Newcastle-on-Tyne.*
29	1888. Oct.	Armstrong, Prof. H. E., PH.D., F.R.S., 55, *Granville Park, Lewisham, S.E.*
601	1890. Oct.	Aspinall, Miles, *Borough Engineer and Surveyor's Office, Worthing.*

Reg. No.	Date of Election.	
652	1891. Nov.	Atkins, Alfred, assoc.m.inst.c.e., f.r.i.b.a., *Wanganui, New Zealand.*
31	1888. Oct.	Aumonier, F., 110, *High Street, Manchester Square, W.*
674	1892. Jan.	Bailey, Thomas Castley, l.r.c.p., m.r.c.p., m.o.h., *Crewe, Cheshire.*
696	1892. Mar.	Baine, Laurence Augustus, m.d., d.p.h., *Dipton, Lintz Green, Durham.*
41	1888. Oct.	Baker, Sir Benjamin, k.c.m.g., ll.d., f.r.s., m.inst.c.e., 2, *Queen's Square Place, Westminster.*
42	1888. Oct.	Baker, R., *Ballingdon House, Green Lanes, N.*
683	1892. Feb.	Barclay, Arthur, assoc.m.inst.c.e., 3, *Castle Street, Oxford Street, W.*
589	1890. May.	Barton, John Isaac, *Ryde, (Ventnor), Isle of Wight.*
634	1891. July	Barwise, Sidney, m.b., d.p.h., m.o.h., *Derbyshire County Council*, 61, *Uttoxeter New Road, Derby.*
591	1890. May.	Bateman, James, *Assistant Engineer, Natal Government Railway.*
47	1888. Oct.	Baugh, Alfred C., *Egerton Street, Wrexham.*
48	1888. Oct.	Bean, Alexander Thomas, 7, *Victoria Street, S.W.*
376	1888. Dec.	†Beard, E. T., *Wallsend, Pevensey, Sussex.*
351	1888. Oct.	Beard, George, *Thickthorn, Kenilworth.*
49	1888. Oct.	Beard, Neville, *The Mount, Ashbourne.*
564	1889. Dec.	Beardmore, George Russell, l.r.c.p.lond., m.r.c.s., l.s.a., d.p.h.camb., *Warwick House, Upper Street, Islington.*
327	1888. Oct.	Beck, Marcus, m.b., 30, *Wimpole Street, W.*
50	1888. Oct.	Beddoe, John, b.a., m.d., f.r.s., *The Chantry, Bradford-on-Avon.*
326	1888. Oct.	Beevor, Mrs. Elizabeth, 129, *Harley Street, W.*
51	1888. Oct.	Bell, Thomas, l.r.c.p.lond., *Uppingham, Rutland.*
115	1888. Dec.	‡Benjamin, Horace Bernton, f.r.g.s., 28, *Albemarle Street, W.*, (37, *Upper Grosvenor Street, W.*).
52	1888. Oct.	Bennett, Hugh, m.r.c.s., *Builth Wells, Brecon.*
690	1892. Mar.	Bennett, William Benjamin George, assoc.m.inst.c.e., *Cranleigh, Portswood Road, Southampton.*
53	1888. Oct.	Bernard, William Larkins, 3, *St. Stephen's Chambers, Baldwin Street, Bristol.*
54	1888. Oct.	†Berrington, R. E. W., assoc.m.inst.c.e., *Graiseley, Wolverhampton.*
694	1892. Mar.	Berry, William Walton, assoc.m.inst.c.e., *Eccles, near Manchester.*
56	1888. Oct.	Bickersteth, E. R., f.r.c.s., 2, *Rodney St., Liverpool.*
619	1891. Mar.	Billingham, J. A. L., *Surveyor, R. Engineers, Royal Engineer Office, Colombo.*
57	1888. Oct.	Black, Surg.-Major W. G., 2, *George Square, Edinburgh.*
467	1889. Mar.	Blair, William Nisbet, assoc.m.inst.c.e., *Vestry Hall, Pancras Road, N.W.*

Reg. No.	Date of Election.	
58	1888. Oct.	BLASHILL, T., F.R.I.B.A., *Superintending Architect, London County Council, Spring Gardens, S.W.*
730	1892. Oct.	BLIZARD, John Henry, ASSOC.M.INST.C.E., F.S.I., *Castle Lane, Southampton.*
466	1889. Mar.	BLUMER, Frederick Milnes, B.A., M.B., M.O.H., *Foregate Street, Stafford.*
417	1889. Feb.	BOLDING, John T., 19, *South Moulton Street, W.*
60	1888. Oct.	BOND, Fredk. Adolphus, M.B., C.M.EDIN., D.P.H.EDIN., *Hetton Lodge, Ferndale, Tunbridge Wells.*
583	1890. Apr.	BOOBBYER, Philip, M.B., M.R.C.S., M.O.H., *The Guildhall, Nottingham.*
377	1888. Dec.	BOSTOCK, H., *The Oaklands, Rowley Avenue, Stafford.*
62	1888. Oct.	BOX, M. H.
63	1888. Oct.	BRACE, W. H., M.D., 7, *Queen's Gate Terrace, S.W.*
64	1888. Oct.	BRACKETT, Wm., 42, *London Road*, (27, *High Street, Street, Tunbridge Wells*).
65	1888. Oct.	BRADSHAW, James D., B.A., M.B., M.R.C.P., M.R.C.S., 30, *George Street, Hanover Square, W.*
635	1891. July.	BRAGA, João Francisco, L.S.A., F.C.S., F.L.S., F.G.S., D.P.H., *Glen Villa, Sunbury-on-Thames.*
469	1889. Mar.	BREBNER, George Reith, M.D., D.P.H., *Bensham Lodge, West Croydon.*
68	1888. Oct.	BRIDGES, J. H., M.B., F.R.C.P., *The Brambles, Wimbledon.*
617	1891. Jan.	BRIGHT, Philip, ASSOC.M.INST.C.E., 2, *Newgate Street, E.C.*
357	1888. Nov.	BRISTOWE, John Syer, M.D., F.R.S., 13, *Old Burlington Street, W.*
506	1889. Apr.	BRODIE, John Shanks, ASSOC.M.INST.C.E., *Town Hall, Whitehaven, Cumberland.*
498	1889. Mar.	BROOKE, Walter, ASSOC.M.INST.C.E., *Albany Buildings*, 39, *Victoria Street, Westminster, S.W.*
517	1889. Apr.	BROOKE, William, M.D., M.O.H., *Shaw, near Oldham.*
671	1892. Jan.	BROWN, Arthur, M.INST.C.E., *The Guildhall, Nottingham.*
728	1892. Oct.	†BROWN, Edwin, *Local Board Offices, Burgess Hill.*
69	1888. Oct.	BROWN, William Ibbs, *St. Michael's Avenue and Guildhall, Northampton.*
662	1891. Dec.	BRUCE, William, M.D., LL.D., M.O.H., *Dingwall, Ross.*
70	1888. Oct.	BRYANT, Thomas, F.R.C.S., 65, *Grosvenor Street, W.*
645	1891. Oct.	BUCKINGHAM, Edward de Vere, *Architect, St. John Street, Winchester.*
379	1888. Dec.	BUCKTON, Mrs. 27, *Ladbroke Square, W.*
629	1891. May.	BULLIS, William Daniel, *Surveyor*, 21, *Finsbury Pavement, E.C.*
633	1891. July.	BULSTRODE, Herbert Timbrell, M.A., M.D., D.P.H., *Local Government Board, Whitehall, S.W.*
416	1888. Dec.	†BUNTEN, Charles, *care of W. F. Watkins*, 8, *Park Road, East Hill, Wandsworth.*

Reg. No.	Date of Election.	
582	1890. Apr.	BURDWOOD, James Watson, L.F.P.S., M.O.H., *West Cottage, Bourne, Lincoln.*
711	1892. May.	BURGESS, Samuel Edwin, ASSOC.M.INST.C.E., *Town Hall, Banbury.*
380	1888. Dec.	BURMESTER, Miss E., 13, *Sussex Square, Hyde Park, W.*
567	1890. Jan.	BURR, Alfred, F.R.I.B.A., 85, *Gower Street, W.C.*
514	1889. Apr.	BURTON, Samuel Hubert, F.R.C.S., M.O.H., 50, *St. Giles's Street, Norwich.*
419	1889. Jan.	†BURTON, W. Kinninmond, ASSOC.M.INST.C.E. *Professor of Sanitary Engineering, Imperial University, Tokio, Japan.*
714	1892. June.	BUTTON, Fred Smith, ASSOC.M.INST.C.E., *Town Hall, and* 13, *Palatine Square, Burnley.*
463	1889. Feb.	†CAMPBELL, Adam Horsburgh, ASSOC.M.INST.C.E., *Borough Surveyor's Office, Stratford-on-Avon.*
78	1888. Oct.	CAMPBELL, Charles, *Queen Insurance Buildings, Church Street, Sheffield.*
329	1888. Oct.	CAMPBELL, HON. Dudley, 1, *Mitre Court Buildings, Temple.*
470	1889. Mar.	CAMPBELL, Kenneth Findlater, ASSOC.M.INST.C.E., *Borough Engineer, Stockton-on-Tees.*
745	1892. Nov.	CANTY, William Henry, *Surveyor*, 40, *Cambridge Street, Prospect Hill, Tunbridge Wells, Kent.*
79	1888. Oct.	CARLINE, John, ASSOC.M.INST.C.E., *Board of Works, Lewisham, S.E.*
500	1889. Mar.	CARLTON, George Brody, ASSOC.M.INST.C.E., *Knighton, Oak Hill Road, Beckenham.*
358	1888. Nov.	CARRITT, Ernest, 18 *&* 19, *Great St. Helens, E.C.*
680	1892. Feb.	CARROLL, John, M.B., C.M., D.P.H., M.O.H., 172, *Station Road, Ilkeston.*
708	1892. May.	CAWS, Edward Isaac, *Sea View, Isle of Wight.*
607	1890. Nov.	CHART, Robert Masters, *Mitcham, Surrey.*
81	1888. Oct.	CHATTERTON, George, M.INST.C.E., 46, *Queen Anne's Gate, S.W.*
82	1888. Oct.	CHATTOCK, Miss Frances C., *Solihull, Birmingham.*
83	1888. Oct.	CLARKE, James Wright, 8, *Salcott Road, Wandsworth.*
84	1888. Oct.	CLARKSON, J. W., M.R.C.S.E., L.R.C.P.L., *c/o Messrs. H. S. King & Co., Pall Mall, S.W.*
598	1890. Oct.	†CLOTHIER, Samuel Thompson, *Street, Somerset.*
701	1892. Apr.	COALES, Herbert George, ASSOC.M.INST.C.E., *Market Harborough, Leicester.*
85	1888. Oct.	COATES, C., F.R.C.P., 10, *Circus, Bath.*
86	1888. Oct.	COCK, Frederick, M.D., 1, *Porchester Houses, Porchester Square.*
332	1888. Oct.	COLLINGRIDGE, W., M.A., M.D., D.P.H., *Port of London Sanitary Offices, Greenwich, S.E.*
330	1888. Oct.	COLLINSON, John, 90, *Cromwell Road, S.W.*
88	1888. Oct.	†COMBER, P. F., M.INST.C.E. IRELAND, *Fairy Hill, Bray, Co. Wicklow.*

Reg. No.	Date of Election.	
726	1892. Sept.	†CONNAL, Eben, M.INST.C.E., 49, *Kerrsland Terrace, Hillhead, Glasgow, Lanark, Scotland.*
89	1888. Oct.	†COOPER, C. H., ASSOC.M.INST.C.E., *Local Board Offices, Wimbledon.*
90	1888. Oct.	COOPER, Francis A., ASSOC.M.INST.C.E., *c/o H. F. Cooper, Nottingham and Notts Bank, Newark.*
359	1888. Nov.	COOPER, John, jun., *Croydon.*
443	1889. Jan.	†COOPER, William, 32, *Cheetham Street, Cheetham, Manchester.*
91	1888. Oct.	CORBETT, Joseph, *Borough Engineer, Town Hall, Salford.*
654	1891. Nov.	CORKE, Cecil A., L.R.C.P., M.O.H., 72, *High Street, Wem, Shropshire.*
666	1891. Dec.	CORNER, John, 543, *Cuyo, Buenos Ayres.*
688	1892. Mar.	CORNISH, William Robert, SURG.-GEN., F.R.C.S., C.I.E., Q.H.P., 8, *Creswell Gardens, S.W.*
92	1888. Oct.	CORSAN, John R., 80, *Gray's Inn Road, W.C.*
93	1888. Oct.	COURTNEY, MAJOR D. C., R.E., 22, *Collingham Gardens, Kensington, S.W.*
545	1889. Oct.	COWAN, Peter Chalmers, B.SC. (EDIN.), ASSOC.M. INST.C.E., *County Surveyor, Downpatrick.*
94	1888. Oct.	COWTAN, Frank, 309, *Oxford Street, W.*
597	1890. Oct.	†‡CRAIG, G. A., *Cambridge Villa, Windermere.*
95	1888. Oct.	CRANBROOK, THE RT. HON. VISCOUNT, G.C.S.I., 17, *Grosvenor Crescent, S.W.*
622	1891. Mar.	CRAWFORD-ROE, William Alexander F.R.C.S.E., *Surgeon-Major Indian Medical Service, Bengal.*
540	1889. June.	CREGEEN, Hugh Stowell, 42, *Freelands Road, Bromley, Kent.*
96	1888. Oct.	†CRIMP, W. Santo, M.INST.C.E., F.G.S., *London County Council, Spring Gardens.*
631	1891. June.	CRISP, James Gregory, 10, "*Esklee,*" *Tivoli, Cheltenham.*
97	1888. Oct.	CROMBIE, James, M.B., D.P.H.EDIN., *Sidcup.*
98	1888. Oct.	CROWLEY, Frederick, *Ashdell, Alton, Hants.*
472	1889. Mar.	CUFF, Robert, M.B., M.R.C.S., M.O.H., 28, *Huntriss Row, Scarborough.*
100	1888. Oct.	†CURWEN, John F., 51, *Highgate, Kendal.*
577	1890. Mar.	DABBS, George Henry Roque, M.D., M.R.C.S., M.O.H., *Highfields, Shanklin, I. of Wight.*
105	1888. Oct.	†DARCH, John, 74, *Sarsfield Road, Balham, S.W.*
709	1892. May.	DAVIS, Alfred T., ASSOC.M.INST.C.E., *Shirehall, Shrewsbury.*
599	1890. Oct.	†DAVIS, Neville Brookes, ASSOC.M.INST.C.E., P.A.SURV. INST., *Water Works Office, Leicester.*
106	1888. Oct.	DAWSON, Charles James, *Surveyor to the Local Board Barking.*
108	1888. Oct.	DAY, Ernest, F.R.I.B.A., 5, *Foregate Street, Worcester.*
731	1892. Oct.	†DAYE, John, 117, *Arran Street, Roath, Cardiff.*
109	1888. Oct.	DEBENHAM, F. G., *Cheshunt Park, Herts.*

Reg. No. Date of Election.

107 1888. Oct. DE CHAUMONT, Miss Anna Kennedy Francois, 86, *Abingdon Road, Kensington, W.*
724 1892. Sept. †DENDY, William Cooper, P.A.S.I., *Surveyors' Department, Lambeth Vestry, Kennington Green, S.E., Surrey.*
110 1888. Oct. DENNIS, Nelson F., *Town Surveyor, West Cowes.*
669 1891. Dec. DENTON, Eardley Bailey, B.A., M.INST.C.E., 9, *Bridge Street, Westminster.*
333 1888. Oct. DE SOLDENHOFF, Richard, 12, *Newport Road, Cardiff.*
699 1892. Apr. DICKINSON, Thomas Rusholm, ASSOC.M.INST.C.E., *Borough Surveyor, Hertford, Herts.*
698 1892. Jan. DICKINSON, William Gilbert, L.R.C.P., M.R.C.S., D.P.H., 1, *Wimbledon Road, Southfields, Wandsworth.*
532 1889. May. DIXEY, Harry Edward, M.D., *Woodgate, Great Malvern.*
725 1892. Sept. †DIXON, Francis Edward, *Local Board Offices, Bamber Bridge in Walton-le-Dale, Lancaster.*
627 1891. May. DODD, Peter, ASSOC.M.INST.C.E., *Engineer and Surveyor, Wandsworth, S.W.*
520 1889. Apr. DONOVAN, Dennis D., L.R.C.P., L.R.C.S., *Superintendent Medical Officer of Health. City of Cork.*
112 1888. Oct. DOULTON, James Duncan, *Lambeth.*
616 1891. Jan. DRAYSON, Walter B. H., 2, *Newgate Street, E.C.*
569 1890. Jan. DRUMMOND, Edward, M.D., M.R.C.S., D.P.H.CAMB., *The Ivy House, Hampstead,* (3, *Piazza di Spagna, Rome*).
516 1889. Apr. EATON-SHORE, George, ASSOC.M.INST.C.E., *Borough Engineer,* 190, *Edlestone Road, Crewe.*
117 1888. Oct. EBURY, RT. HON. LORD, *Moor Park, Rickmansworth.*
334 1888. Oct. ECCLES, Miss Jane Helen, 3, *Dean's Yard, Westminster, S.W.*
618 1891. Feb. EDGE, Frederic James, ASSOC.M.INST.C.E., *Public Offices, Cleator Moor, Cumberland.*
118 1888. Oct. ELFORD, John, *Borough Surveyor, Poole, Dorset.*
713 1892. June. ELLIOT, Robert Henry, M.B.LOND., D.P.H., *Madras Medical Service, Madras.*
383 1888. Dec. EMERSON, W., F.R.I.B.A., 8, *The Sanctuary, S.W.*
692 1892. Mar. ENTWISTLE, Henry, *Local Board Offices, Swinton, Lancaster.*
420 1889. Jan. ERICHSEN, J. Eric, F.R.S., 6, *Cavendish Place, W.*
360 1888. Nov. EVERS, SURG.-MAJOR B., *care of Messrs. Watson Bros.,* 27, *Leadenhall Street, E.C.*
421 1889. Jan. FARRER, SIR T. H., BART., 27, *Bryanston Square, W.*
695 1892. Mar. FARRINGTON, William, *Town Hall, Hoyland Nether, Yorkshire.*
123 1888. Oct. FAWCETT, William Milner, M.A., F.R.I.B.A., 1, *Silver Street, Cambridge.*
637 1891. July. †‡FELKIN, Howard Riley, 23, *Brackley Road, Chiswick.*
124 1888. Oct. FERNIE, C. W. B., *Keythorpe, Leicester.*
125 1888. Oct. FIELD, Horace, 14, *Gray's Inn Square, W.C.*

Reg. No.	Date of Election.	
127	1888. Oct.	Fisher, T. J., 50, *Thorne Road, South Lambeth.*
721	1892. Sept.	Fletcher, Walter John, F.R.I.B.A., *Wimborne, Dorset.*
639	1891. Oct.	†‡Flower, Thomas James Moss, *Carlton Chambers, Baldwin Street, Bristol.*
128	1888. Oct.	Forde, H. C., M.INST.C.E., 4, *Great Winchester Street, E.C.*
630	1891. May.	Fosbroke, G. H., M.R.C.S., D.P.H., M.O.H., *The County Hall, Worcester.*
129	1888. Oct.	Foster, Reginald Le Neve, F.C.S., *North Road, Droylsdon, Manchester.*
743	1892. Nov.	Fowler, Alfred Mountain, M.INST.C.E., 1, *St. Peter's Square, Manchester, Lancaster.*
130	1888. Oct.	Frank, Philip, M.D., *Cannes, France.*
131	1888. Oct.	Fraser, James, M.INST.C.E., 100, *Castle Street, Inverness.*
422	1889. Jan.	Fraser, W. J., ASSOC.M.INST.C.E., 98, *Commercial Road, E.*
135	1888. Oct.	Galton, Francis, F.R.S., 42, *Rutland Gate, S.W.*
474	1889. Mar.	Gange, Frederick A., M.D., M.O.H., *Faversham, Kent.*
732	1892. Oct.	Gay, John, M.R.C.S., L.R.C.P., D.P.H., 119, *Upper Richmond Road, Putney, S.W.*
136	1888. Oct.	†Geen, Harry, *Hillside, Okehampton, Devon.*
636	1891. July.	†‡Gibbs, Arthur Gordon, *Surveyor's Office, Midhurst.*
560	1889. Dec.	†Gibson, William, *Bonhay Road, Exeter.*
441	1889. Jan.	†Gilby, Charles, *Bath.*
137	1888. Oct.	Gill, D., *Farleigh, Weston-super-Mare.*
650	1891. Nov.	Gilliland, William John, *Architect*, 74, *Royal Avenue, Belfast.*
385	1888. Dec.	Gladstone, J. H., PH.D., F.R.S., 17, *Pembridge Square, W.*
676	1892. Jan.	Glaister, John, M.D., D.P.H., 101, *Great Russell Street, W.C.*
386	1888. Dec.	Glen, A. W., 33, *Davies Street, Berkeley Square, W.*
373	1890. Mar.	Godfrey, Robert, ASSOC.M.INST.C.E., *King's Heath, Worcestershire.*
613	1891. Jan.	Going, Joseph A., M.R.C.S , B.A., M.O.H., *Fox Bay, West Falkland Islands, South America.*
546	1889. Nov.	Goodyear, Herbert, ASSOC.M.INST.C.E., *Colchester, Essex.*
518	1889. Apr.	Grant, Ogilvie, M.B., C.M.EDIN., M.O.H., *Queen Mary's House, Inverness.*
686	1892. Feb.	Grantham, Richard Fuge, M.INST.C.E., *Northumberland Chambers, Northumberland Avenue, S.W.*
139	1888. Oct.	Gray, Alexander, 25, *Greenhill Road, Hampstead, N.W.*
581	1890. Apr.	Greatorex, Albert Daniel, *Municipal Offices, Southampton.*
718	1892. July.	†Green, William Samuel, *Idridgehay, Derby.*

Reg. No.	Date of Election.	
705	1892. Apr.	Gregson, John, assoc.m.inst.c.e., *Woodbine House, Padiham, Lancaster.*
140	1888. Oct.	Grellier, William, f.r.i.b.a., 6, *Queen Anne's Gate, S.W.*
335	1888. Oct.	Groves, Joseph, b.a., m.d., f.g.s., *Carisbrooke, Isle of Wight.*
566	1890. Jan.	Gruggen, William, d.p.h., 11, *Montpelier Road, Ealing, W.*
337	1888. Oct.	Hall, E. T., f.r.i.b.a., 57, *Moorgate Street, E.C.*
620	1891. Mar.	Hall, Watkin, assoc.m.inst.c.e., *Local Board Offices, College Road, Gt. Crosby, Lancashire.*
612	1891. Jan.	Hamilton, Walter M., m.d., 456, *Liverpool Road, Patricroft, Lancashire.*
687	1892. Mar.	Hampton, Willie Thomas, f.s.i., *Shakespeare House, Loughborough, and Hotel Street, Coalville, Leicester.*
148	1888. Oct.	Hancock, Charles, m.a.oxon, 2, *The Cloisters, Temple, E.C., and Reform Club, S.W.*
746	1892. Nov.	Hardwicke, William Wright, m.d. St. Andrews m r.c.p., j.p., *Medical Officer of Health for Harwich, Stour House, Dovercourt, Essex.*
610	1890. Dec.	Hanson, John, *Victoria Chemical Works, Wakefield.*
475	1889. Mar.	Harding, J. R., m.inst.c.e., *Epsom, Surrey.*
505	1889. Apr.	Hare, C. J., m.d., f.r.c.p., *Berkeley House*, 15, *Manchester Square, W.*
476	1889. Mar.	Harpur, William, m.inst.c.e., *Town Hall, and* 197, *Severn Road, Cardiff.*
579	1890. Apr.	Harris, Arthur Wellesley, m.r.c.s., l.s.a., d.p.h., m.o.h., *High Street, Southampton.*
151	1888. Oct.	Harrisson, Thomas Harnett, assoc.m.inst.c.e., *Central Buildings, North John Street, Liverpool.*
747	1892. Nov.	Harrison, William Joseph, assoc.m.inst.c.e., f.r.met.soc., 7, *Carteret Street, Westminster, S.W.*
387	1888. Dec.	Harrold, Miss C., 10, *Church Road, Edgbaston, Birmingham.*
618	1891. Nov.	Haslam, Dryland, Junr., p.a.s.i., 17, *Friar Street, Reading.*
338	1888. Oct.	Haslam, Lewis, *Ravenswood, near Bolton.*
626	1891. Apr.	Haslip, George Ernest, m.d., m.r.c.s., l.r.c.p., d.p.h., 3, *Southampton Street, Strand.*
152	1888. Oct.	Hayward, C. F., f.s.a., f.r.i.b.a., 47, *Museum Street, Bloomsbury, W.C.*
339	1888. Oct.	Head, Henry, *Buckingham, Old Shoreham, Sussex.*
418	1889. Feb.	Head, Mrs. H., *Buckingham, Old Shoreham, Sussex.*
153	1888. Oct.	Hellyer, S. Stevens, 21, *Newcastle Street, Strand, W.C.*
477	1889. Mar.	Herbert, Johnson, l.r.c.p., 3, *Belle Vue Terrace, Whitby.*
390	1888. Dec.	Hill, Miss F. M. Davenport, 25, *Belsize Avenue, N.W.*
389	1888. Dec.	Hill, Miss R. Davenport, 25, *Belsize Avenue, N.W.*

Reg. No.	Date of Election.	
423	1889. Jan.	Hill, Pearson, 6, *Pembridge Square, W.*
614	1891. Jan.	Hill, Prof. A. Bostock, M.D., D.P.H., M.O.H., *Elmhurst, Olton, Birmingham.*
155	1888. Oct.	Hill, Samuel, A.R.I.B.A., 16, *Russell Square, W.C.*
156	1888. Oct.	Hill, William H., *Town Hall, Kensington.*
642	1891. Oct.	†Hills, Harry James, 14, *Werrington Street, Camden Town, N.W.*
679	1892. Feb.	Hobson, John Morrison. M.D., D.P.H., *Croydon.*
457	1889. Mar.	Hodgetts, E. A. Brayley, 39, *Redcliffe Square, South Kensington, S.W., and Agence Dalziel,* 50, *Rue des Victoires, Paris, N.W.*
157	1888. Oct.	Hodgson, Shadworth H., 45, *Conduit Street, W.*
638	1891. July.	Hodgson, William James, ASSOC.M.INST.C.E., *High Park, Near Ryde, Isle of Wight.*
581	1890. Apr.	Holberton, Henry Nelson, L.R.C.P., M.R.C.S., D.P.H., *East Moulsey.*
158	1888. Oct.	Holmes, Timothy, M.A., F.R.C.S., 18, *Great Cumberland Place, W.*
159	1888. Oct.	Holt, H. P., ASSOC.M.INST.C.E., F.G.S., *The Cedars, Didsbury, Manchester.*
653	1891. Nov.	Holroyde, John, M.R.C.S., L.S.A., D.P.H., M.O.H., *Camden House, Chatham.*
478	1889. Mar.	Hooley, Cosmo C., ASSOC.M.INST.C.E., *The Union Offices, Barton-upon-Irwell, Manchester.*
553	1889. Nov.	Hooper, Charles, M.R.C.S., M.O.H., *Aylesbury, Bucks.*
415	1889. Jan.	†‡Houghton, John, *Poplar Road, King's Heath, near Birmingham.*
161	1888. Oct.	Howard, E., 84, *Upper Whitecross Street, E.C.*
162	1888. Oct.	Howe, George, 41, *Wigmore Street, W.*
593	1890. June.	‡Hoy, Peter, 7, *Park Place, Clarence Gate, N.W.*
163	1888. Oct.	†Hubber, Frank, 85, *South Street, Exeter.*
610	1891. Oct.	†Hunt, John W., *Maindee, Newport, Monmouth.*
682	1892. Feb.	Hunter, Alexander H., *Surveyor and Sanitary Inspector, Oswestry, Salop.*
391	1888. Dec.	Inglis, Cornelius, M.D., 1, *Albert Mansions, Victoria Street, S.W.*
661	1891. Nov.	Ingram, Matthew, *Manchester.*
588	1890. May.	Ivor-Moore, T., *Fairfield Gold Tops, Newport, Mons.*
605	1890. Nov.	†James, Arthur Charles, *Borough Surveyor's Office, Cambridge.*
527	1889. May.	James, Charles Alfred, L.R.C.P, M.R.C.S., D.P.H., 24, *Cazenove Road, Stamford Hill, N.*
658	1891. Nov.	Johnson, Samuel, M.D., C.M., M.O.H., *Stoke-on-Trent.*
702	1892. Apr.	Jones, Charles, M.INST.C.E., *Local Board, Ealing, Middlesex.*
641	1891. Oct.	†Kay, Walter Robert, *Mount Sion House, Bury.*
502	1889. Mar.	Kempster, William Henry, M.D., M.O.H., *Oak House, Battersea.*

Reg. No.	Date of Election.	
704	1892. Apr.	KENDELL, Daniel Burton, M.B.CANTAB., *Thornhill House, Walton, Wakefield.*
168	1888. Oct.	KENNETT-BARRINGTON, SIR Vincent Hunter B., 65, *Albert Hall Mansions, Kensington Gore.*
675	1892. Jan.	KENWOOD, Henry R., M.B., L.R.C.P., D.P.H., F.C.S., 189, *Adelaide Road, Hampstead, N.W.*
717	1892. July.	†KILFORD, Henry James, *Borough Surveyor, Ilkeston, Derby.*
559	1889. Dec.	KIRBY, Oscar John, *Engineer and Manager Water Works, Batley.*
501	1889. Mar.	KIRWAN, SURGEON-MAJOR A., D.P.H., *St. Lucia, West Indies.*
479	1889. Mar.	KYLE, Thomas W., M.D., D.P.H., M.O.H., *Measham, Atherstone.*
174	1888. Oct.	LACY, William George, 82, *East Hill, Wandsworth.*
710	1892. May.	LAFFAN, George Bastable, ASSOC.M.INST.C.E., *Local Board Offices, Queen's Road, Twickenham.*
534	1889. May.	LAING, R., M.R.C.S., L.R.C.P., F.R.MET.SOC., M.O.H., 29, *Waterloo Road, Blyth, Northumberland.*
393	1888. Dec.	LAVENDER, Charles Henry Nalder, 2, *Ulster Terrace, Regent's Park, N.W.*
748	1892. Nov.	LAW, Herbert Henry, ASSOC.M.INST.C.E., 17, *Victoria Street, S.W.*
693	1892. Mar.	LAWFORD, George Maxwell, ASSOC.M.INST.C.E., M.SOC.E., 13, *Victoria Street, S.W.*
175	1888. Oct.	LAWRENCE, Edwin, 10, *Kensington Palace Gardens, W.*
177	1888. Oct.	LE GRAND, A., 125, *Bunhill Row, E.C.*
178	1888. Oct.	LEMON, James, M.INST.C.E., F.R.I.B.A., F.S.I., F.G.S., *Lansdowne House, Southampton, (Palace Chambers, Westminster).*
179	1888. Oct.	LEONARD, Hugh, 7, *Hanover Square, W.*
180	1888. Oct.	LE ROSSIGNOL, Francis, F.S.I., 1, *Gresham Buildings, Basinghall Street, E.C.,* (29, *Penn Road Villas, Camden Road, N.*).
536	1889. June.	LETTS, Thomas Hollins, 185, *Earls Court Road, South Kensington.*
742	1892. Oct.	LEWIS, Thomas Laurence, *Engineer and Surveyor, St. George, Gloucester.*
182	1888. Oct.	LINGARD, J. Edward, *Rodney Chambers, Derby.*
673	1892. Jan.	LITTLE, John Fletcher, M.B., M.R.C.P., M.O.H., 60, *Welbeck Street, W.*
183	1888. Oct.	LLOYD, Robert Samuel, 84 & 85, *Whitecross Street, E.C.*
575	1890. Mar.	LOANE, Joseph, M.R.C.P.E., D.P.H., M.O.H., 98, *Tressillian Road, St. John's, S.E.*
507	1889. Apr.	LOCKWOOD, Phillip Causton, M.INST.C.E., 1, *Gloucester Place, Brighton.*
700	1892. Apr.	LOWE, Louis J., *Cassilla,* 448, *Buenos Ayres, Argentine Republic, South America.*

Reg. No.	Date of Election.	
425	1889. Jan.	Lowe, Mrs. Thomas, *Solihull, Birmingham.*
632	1891. June.	Lynde, Frederick Charles, assoc.m.inst.c.e., 25, *Cross Street, Manchester,* (9, *Victoria Street, S.W.*).
185	1888. Oct.	Lyon, Washington, 85, *Asylum Road, Peckham, S.E.*
189	1888. Oct.	Macassey, L. Livingston, m.inst.c.e., 1, *Plowden Buildings, Temple, E.C.*
190	1888. Oct.	‡Mackenzie, F. Morell, m.r.c.s., l.s.a., 10, *Hans Place, S.W.*
656	1891. Nov.	Mackenzie, William Leslie, m.a., m.b., c.m., d.p.h., County m.o.h., *Castle Douglas, N.B.*
191	1888. Oct.	Mackey, John B., 2, *Bouverie Street, Fleet Street, E.C.*
458	1889. Mar.	Macnamara, Charles Edward, l.k.q.c.p.i., d.p.h., 95, *Stephen's Green, Dublin.*
396	1888. Dec.	McArthur, A., m.p., 79, *Holland Park, W.*
600	1890. Oct.	McBeath, William, m.a., m.d., d.p.h., 7, *Flora Place, Plymouth.*
198	1888. Oct.	McIntosh, James, *Duneevan, Oatlands Park, Weybridge.*
342	1888. Oct.	McKie, Hugh Umsworth, m.inst.c.e., 11, *Victoria Street, Westminster.*
199	1888. Oct.	McMorran, Alexander, *Galloway House, Carlton Road, Putney.*
580	1890. Apr.	McNeill, Roger, m.d., d.p.h., j.p., *County Medical and Sanitary Officer, Oban.*
193	1888. Oct.	†Maguire, William Robert, f.r.met.soc., 10, *Dawson Street, Dublin,* (*Town Hill, Dalkey, Co. Dublin*).
194	1888. Oct.	Maltby, Frederic Thomas, assoc.m.inst.c.e., *Surveyor's Office, Guildford.*
672	1892. Jan.	Manley, Herbert, m.a., m.b., d.p.h., m.o.h., *West Bromwich.*
594	1890. July.	Marsden, James Aspinall, m.r.c.s., l.s.a., d.p.h., m.o.h., *Standish, Wigan, Lancashire.*
736	1892. Oct.	Marsden, Robert Sidney, m.b., d.sc., f.r.s.e., m.o.h., 65, *Grange Mount, and Town Hall, Birkenhead.*
412	1888. Dec.	Martindale, William, 10, *New Cavendish Street, W.*
195	1888. Oct.	Martineau, E. H., f.r.i.b.a., 30, *Weymouth Street, Portland Place, W.*
196	1888. Oct.	Mason, Hugh H., m.r.c.s., *Abbey Lodge, Barking.*
557	1889. Nov.	†‡Massey, Joseph Bennett, 64, *Burns Street, Burnley, Lancaster.*
681	1892. Feb.	Massie, Frank, assoc.m.inst.c.e., f.s.i., f.r.met.soc., *Tetley House, Wakefield.*
197	1888. Oct.	Mathews, J. Douglass, f.r.i.b.a., f.s.i., 11, *Dowgate Hill, E.C.*
200	1888. Oct.	†Mawbey, E. G., assoc.m.inst.c.e., *Borough Engineer and Surveyor, Town Hall, Leicester.*

Reg. No.	Date of Election.	
313	1888. Oct.	MELISSENOS, G. C. A. Melisurgo, ASSOC.M.INST.C.E., *Palazzo Cocozzo*, 76, *Via Poerio*, *Naples.*
201	1888. Oct.	†METCALF, John W., 31, *Tamworth Road*, *Ashby-de-la-Zouch.*
651	1891. Nov.	METCALFE, James, 5, *Nether Hall Road*, *Doncaster.*
204	1888. Oct.	MINEARD, George Edward, F.R.H.S., 70, *Philbeach Gardens*, *Earl's Court*, *S.W.*
738	1892. Oct.	†MITCHELL, Lewis, 79, *Scott Street*, *Glasgow.*
663	1891. Dec.	MITCHELL, Robert, *Consulting Sanitary Engineer*, *Cape Town*, *South Africa.*
205	1888. Oct.	MOCATTA, F. D., 9, *Connaught Place*, *W.*
207	1888. Oct.	MONTAGU, Samuel, 12, *Kensington Palace Gardens*, *W.*
691	1892. Mar.	MOORE, Albert, M.S.C.I., L.R.C.V.S., F.I.C., 21, *Holcroft Pavement*, *Fulham*, *Middlesex.*
206	1888. Oct.	MOORE, J. H., *St. Michael's Lodge*, *Bournemouth.*
668	1891. Dec.	MORE, James, Jun., ASSOC.M.INST.C.E., F.R.MET.SOC., 49, *Orlando Road*, *Clapham*, *S.W.*
572	1890. Mar.	MORGAN, William Pringle, B.A., M.B., B.CH., D.P.H., *Hardis House*, *Seaford.*
628	1891. May.	MORGAN, William Barlow, ASSOC. M. INST. C. E., *Surveyor*, *Weymouth.*
542	1889. July.	MORISON, John, M.D., D.P.H., *Victoria Street*, *St. Albans.*
643	1891. Oct.	†MORLEY, Edwin, *Town Hall*, *Walthamstow.*
208	1888. Oct.	†MORLEY, J. G., ASSOC.M.INST.C.E., *Town Hall*, *Stratford*, *E.*
615	1891. Jan.	MORRIS, Albert, M.R.C.S., L.R.C.P., *Post Office Buildings*, *Southend.*
750	1892. Nov.	‡MORRIS, Griffith John, *R.E. Establishment*, *Barbadoes.*
528	1889. May.	MORRIS, Pryce Jones Langford, M.R.C.S., L.R.C.P., M.O.H., *Halesworth*, *Suffolk.*
210	1888. Oct.	MOUAT, F. J., M.D., 12, *Durham Villas*, *Kensington*, *W.*
211	1888. Oct.	MOUAT, SURGEON-GENERAL J., C.B., F.R.C.S., 108, *Palace Gardens Terrace*, *W.*
213	1888. Oct.	MUMBY, B. H., M.D., D.P.H., M.R.C.S., M.O.H., *Portsmouth.*
512	1889. Apr.	MUNCE, James, ASSOC.M.INST.C.E., *Town Hall*, *Belfast.*
563	1889. Dec.	MUNDAY, MAJOR Henry, 23, *Oakley Square*, *N.W.*
519	1889. Apr.	MURPHY, Francis Henry Swinton, M.D., D.P.H., *Royal Arsenal*, *Woolwich.*
215	1888. Oct.	NANSON, Tom, 9, *Park Crescent*, *Stockwell Park Road*, *S.W.*
362	1888. Nov.	NASH, BRIGADE-SURGEON William, M.D., 18, *Victoria Street*, *Westmister*, *S.W.*
529	1889. May.	NASMYTH, Thomas Goodall, M.B., C.M., D.P.H., F.R.S.E., *Cowdenbeath*, *Fife.*

Reg. No.	Date of Election.	
459	1889. Mar.	NELSON, E. M., *Hanger Hill House, Ealing.*
216	1888. Oct.	NELSON, George H., *The Lawn, Warwick.*
733	1892. Oct.	†‡NEWMAN, Reginald William, 53, *Barnmead Road, Kent House, Beckenham, Kent.*
217	1888. Oct.	NEWTON, Edward, F.R.C.S., 85, *Gloucester Place, Hyde Park, W.*
220	1888. Oct.	†NICHOLS, H. Bertram, ASSOC.M.INST.C.E., *Grosvenor Chambers, Corporation Street, Birmingham.*
219	1888. Oct.	NICOL, W. E., *Ballogie, Aboyne, Aberdeen.*
609	1890. Dec.	NUNN, F. C., ASSOC.M.INST.C.E., *Eastnor, Sydenham Hill, Surrey.*
228	1888. Oct.	PAGE, Herbert Markant, M.D., D.P.H.CAMB., M.R.C.S., 16, *Prospect Hill, Redditch.*
230	1888. Oct.	PAGLIARDINI, T., 21, *Alexander Street, Westbourne Park, W.*
531	1889. May.	PARKER, G. R., M.R.C.S., L.R.C.P., M.O.H., 34, *King Street, Lancaster.*
503	1889. Mar.	PARKER, John, ASSOC.M.INST.C.E., 42, *Dryden Street, Nottingham.*
578	1890. Mar.	†PARKER, John, ASSOC.M.INST.C.E., *City Engineer, Hereford.*
720	1892. July.	PARKER, John Edward, ASSOC.M.INST.C.E., *Surveyor and Sanitary Inspector, Lanchester, Durham.*
231	1888. Oct.	PARKES, Miss P., 8, *Grove Road, Surbiton, S.W.*
716	1892. July.	PARKIN, John Robert, ASSOC.M.INST.C.E., *Idridgehay, Derby.*
233	1888. Oct.	PARSONS, H. Franklin, M.D., *Local Government Board, Whitehall, S.W.*
481	1889. Mar.	PARTRIDGE, Thomas, M.R.C.P.I., M.K.Q.C.S.I., L.S.A., M.O.H., *Stroud, Gloucester.*
722	1892. Sept.	PASTEUR, William, M.D., F.R.C.P., 4, *Chandos Street, Cavendish Square, Middlesex.*
530	1889. May.	PATTEN, Charles Arthur, L.R.C.P., M.O.H., *Ealing.*
234	1888. Oct.	PATTINSON, S., *Ruskington, Sleaford, Lincoln.*
399	1888. Dec.	PEAKE, Francis, *The Waldrons, Croydon.*
719	1892. July.	PEARSE, Thomas Frederick, M.D., F.R.C.S., M.R.C.P., D.P.H., 12, *Norfolk Street, Southsea, Hants.*
400	1888. Dec.	PEEL, Edmund, *Brynfys, Ruabon, North Wales.*
236	1888. Oct.	†PHILLIPSON, Burton R., *Baggot Street, Dublin.*
660	1891. Nov.	PILLEY, John J., 2, *Malfort Road, Denmark Hill, S.E.*
749	1892. Nov.	PLATT, Samuel Sydney, ASSOC.M.INST.C.E., *Borough Surveyor, Town Hall, Rochdale.*
751	1892. Dec.	‡POULSON, Frederick Thomas, *County Sanitary Inspector*, 9, *Lime Tree Avenue, Tollington Street, Stafford.*
237	1888. Oct.	POWELL, George Thompson, *Rotherwood, Sydenham Hill*, (28 *and* 29, *St. Swithin's Lane, E.C.*).
344	1888. Oct.	POWELL, J., 19, *Castle Street, Liverpool.*

Reg. No.	Date of Election.	
402	1888. Dec.	Priestly, Mrs. Eliza, 17, *Hertford Street, Mayfair.*
315	1888. Oct.	Pritchett, G. E., F.S.A., F.R.I.B.A., *Oak Hall, Bishop's Stortford*, (1, *Hanway Place, Oxford Street, W.*).
238	1888. Oct.	Pullar, Robert, J.P., F.R.S.E., *Tayside, Perth.*
239	1888. Oct.	Pullin, T. H. S., M.D., F.R.C.S., F.S.A., *Sidmouth, Devon.*
240	1888. Oct.	Purnell, W. J., *Vincent Row, Vincent Street, Westminster.*
241	1888. Oct.	Purnell, E. W.. *Vincent Row, Vincent Street, S.W.*
243	1888. Oct.	Quain, Sir R., Bart., M.D., F.R.S., 67, *Harley Street, W.*
550	1889. Nov.	†‡Radcliffe, Joseph, F.R.MET.SOC., *The Waterworks, Todmorden, Lancaster.*
604	1890. Nov.	Radford, John Charles, ASSOC.M.INST.C.E., *Surveyor*, 113, *High Street, Putney.*
249	1888. Oct.	†Radford, W. H., ASSOC.M.INST.C.E., A.R.I.B.A., *Pelham Chambers, Angel Row, Nottingham.*
482	1889. Mar.	†Railton, James, *Town Hall, Lower Edmonton.*
586	1890. Apr.	Rainger, Charles Henry, 9, *Bath Place, Cheltenham.*
483	1889. Mar.	Read, Richard, ASSOC.M.INST.C.E., *City Surveyor, Gloucester.*
741	1892. Oct.	Redman, Robert Wilkins, *Borough Surveyor, Deal, Kent.*
363	1888. Nov.	Reynolds, Mrs. Russell, 38, *Grosvenor Street, W.*
574	1890. Mar.	Rhodes, John William, 7, *Mitre Court Chambers, Temple, E.C.*
707	1892. Apr.	Richardson, William, M.D., B SC.P.H., *Lunatic Asylum, Union Mills, Isle of Man.*
740	1892. Oct.	†Ridgway, Ernest Reginald, *Long Eaton, Derby.*
251	1888. Oct.	Ridings, H. Sadleir, M.A., M.INST.C.E., *Care of H. S. King & Co.*, 65, *Cornhill, E.C.*
253	1888. Oct.	Roberts, Frederick F., M.D., 102, *Harley Street, W.*
571	1890. Jan.	Roberts, Richard Lawton, M.D., D.P.H.CAMB., M.R.C.S., L.S.A., *Ruabon, North Wales.*
403	1888. Dec.	Robins, Edward, 22, *Conduit Street, W.*
703	1892. Apr.	Robinson, James, ASSOC.M.INST.C.E., *County Surveyor, Winchester, Hants.*
404	1888. Dec.	Roe, Surgeon-Major, E. A. H., 17, *Whitehall Place, S.W.*
515	1889. Apr.	Rogers, George Arthur, M.R.C.S.E., L.S.A., M.O.H., 404, *Commercial Road, E.*
735	1892. Oct.	Ross, Percival, ASSOC.M.INST.C.E., *Surveyor to North Burley Local Board, Bradford.*
254	1888. Oct.	Roth, W. M.D., 6, *Kaizer Wilhelm Platz, Dresden, N.*
255	1888. Oct.	Russell, Hon. Lady Agatha, *Pembroke Lodge, Richmond Park, Surrey.*
649	1891. Nov.	†Saise, Alfred John, *Stapleton, Bristol.*
484	1889. Mar.	Sandell, Henry W. Adrian, M.R.C.S., M.O.H., *Leighton Buzzard.*

Reg. No.	Date of Election.	
681	1892. Feb.	SAUNDERS, Henry Ingatton, *St. Regulus, Antiers Road, Southampton.*
485	1889. Mar.	SCHOFIELD, Gerald, M.R.C.S., L.R.C.P., D.P.H., *Durham House, Bournemouth.*
262	1888. Oct.	SCOTT, Bowes, *Broadway Chambers, S.W.*
657	1891. Nov.	SCOTT, Conway, *Executive Sanitary Officer, Town Hall, Belfast.*
486	1889. Mar.	SCOTT, Hugh Hamilton, ASSOC.M.INST.C.E., *Town Hall, Hove, Brighton.*
263	1888. Oct.	SCOTT-MONCRIEFF, W. D., M.I.M.E., 86, *Newman Street, W.*
739	1892. Oct.	SCOTT, Robert Smith, ASSOC.M.INST.C.E., *Town Surveyor, Bishop Stortford.*
264	1888. Oct.	SCRIVEN, J. Barclay, M.R.C.S., 95, *Oxford Gardens, North Kensington.*
414	1888. Dec.	SEARLES-WOOD, Herbert D., F.R.I.B.A., 157, *Wool Exchange, E.C.*
429	1889. Jan.	SELBY, Prideaux, *Koroit, North Park, Croydon.*
487	1889. Mar.	SELLERS, William, Junr., M.D., M.O.H., *Bank House, Radcliffe, Manchester.*
488	1889. Mar.	SHADWELL, St. Clair B., L.R.C.P., M.R.C.S., M.O.H., *Lynhurst, Walthamstow.*
489	1889. Mar.	SHAW, Charles Knox, L.R.C.P., M.R.C.S., 19, *Upper Wimpole Street, W.*
524	1889. Apr.	SHAW, Josephus, M.R.C.S., L.S.A., M.O.H., 151, *Lower Road, Rotherhithe.*
644	1891. Oct.	SHELBOURN, Michael, *Architect and Surveyor, Belvoir, Grantham.*
659	1891. Nov.	SHIMELD, James, L.R.C.P. and S.E., M.O.H., *Salisbury House, Ilford.*
490	1889. Mar.	SHIRTLIFF, Edward Matthew, M.D., M.O.H., *Elm Side, Kingston-on-Thames.*
430	1889. Jan.	SHONE, Isaac, ASSOC.M.INST.C.E., *Gt. George Street Chambers, S.W.*
266	1888. Oct.	SHONKSMITH, John Henry, *Micklegate, York.*
267	1888. Oct.	SILLAR, W. C., *St. James' Lodge, Kidbrooke Park Road, Blackheath, S.E.*
411	1888. Dec.	SIMPSON, William John, M.D., D.P.H.CAMB., *Health Officer, Calcutta.*
269	1888. Oct.	SIORDET, James Lewis, M.B., F.R.C.P., *Mentone, Alpes-Maritimes, France.*
270	1888. Oct.	SKRINE, Henry Duncan, *Claverton Manor, Bath.*
539	1889. June.	†‡SMITH, Charles Chambers, *Surveyor's Office, Dalton-in-Furness.*
677	1892. Jan.	SMITH, James Dear, M.D., D.P.H., 16, *Nelson Road, Southsea.*
97	1892. Mar.	SMITH, John, ASSOC.M.INST.C.E., *County Surveyor's Office, Ballinasloe, Galway.*
271	1888. Oct.	SMITH, Percival Gordon, F.R.I.B.A., *Highfield, Stonebridge Park, Willesden.*

Reg. No.	Date of Election.	
272	1888. Oct.	SMITH, R. W., *Mount Rundell, Harborne, Birmingham.*
273	1888. Oct.	SMITH, Thos. Fredk. H., F.R.C.S., L.S.A., *Farningham, Kent.*
449	1889. Feb.	SMITH, T. V., 111, *Grosvenor Road, S.W.*
727	1892. Sept.	SMITH, Urban A., ASSOC.M.INST.C.E., 2, *Victoria Mansions, Westminster.*
431	1889. Jan.	SNELL, Alfred, W., A.R.I.B.A., 1, *Park Road, Wimbledon.*
513	1889. Apr.	SOUTHAM, Arthur, ASSOC.M.INST.C.E., 60, *Old Town, Clapham.*
274	1888. Oct.	STAINTHORPE, W. Waters, M.D., D.P.H.EDIN., *Saltburn-by-the-Sea.*
723	1892. Sept.	†STANBURY, W. H., *Royal Engineer's Office, Freetown, Sierra Leone, W. Coast of Africa.*
275	1888. Oct.	STANSFIELD-BRUN, J., F.R.I.B.A., *District Surveyor, Bradford-on-Avon.*
521	1889. Apr.	STEEL, William D., M.D., M.O.H., D.P.H., *Neville Street, Abergavenny.*
493	1889. Mar.	STEEVES, George Walter, B.A., M.D., M.O.H., 53, *Parkfield Road, Liverpool.*
276	1888. Oct.	STEPHENSON, J. Gurdon L., ASSOC.M.INST.C.E., M.I.M.E., F.G.S., 6, *Drapers Gardens, E.C.*, (14, *Maxilla Gardens, Notting Hill, W.*).
602	1890. Oct.	STEVENS, Joseph Wallace, *Belph, Whitwell, near Chesterfield.*
277	1888. Oct.	STEVENSON, Thomas, M.D., 45, *Gresham Road, S.W.*
494	1889. Mar.	STEWART, Alan, *Maldon, Essex.*
433	1889. Jan.	STIFF, Ebenezer, *London Pottery, Lambeth.*
278	1888. Oct.	STONE, W. H., *Lea Park, Godalming.*
279	1888. Oct.	STREET, William C., A.R.I.B.A., ASSOC.INST.C.E., 7, *Victoria Street, Westminster, S.W.*
405	1888. Dec.	SUDELEY, RIGHT HON. LORD, 7, *Buckingham Gate, S.W.*
439	1889. Jan.	†SWAINSON, John Henry, M.S.A., ASSOC.M.INST.C.E., 59, *Hope Street, Wrexham.*
438	1889. Jan.	†SWAN, Harold, 114, *Trinity Road, Upper Tooting.*
406	1888. Dec.	SWINBURNE, C. A., *Belgrave Mansions, Grosvenor Gardens, S.W.*
667	1891. Dec.	SWINNERTON, Robert Allen William, ASSOC.M.INST.C.E., M.I.M.E., *Bolarum, Dekkan, India.*
495	1889. Mar.	SYKES, Matthew Carrington, L.R.C.P., M.R.C.S., D.P.H., *Barnsley.*
284	1888. Oct.	†TATTERSALL, W., 90, *Arden Terrace, Accrington.*
287	1888. Oct.	TAYLOR, Charles, M.R.C.S., L.S.A., 3, *Lorraine Road, Holloway, N.*
434	1889. Jan.	TAYLOR, Wm. Fredk., M.D., M.R.C.S., L.S.A., *Brisbane, Queensland.*
288	1888. Oct.	TEALE, T. Pridgin, M.A., M.B., F.R.C.S., F.R.S., 38, *Cookridge Street, Leeds.*

Reg. No. Date of Election.

729 1892. Oct. Thomas, John, ASSOC.M.INST.C.E., *Engineer, Swansea R.S.A.*, 14, *Finsbury Terrace, Swansea.*

289 1888. Oct. Thomas, Walter, ASSOC.M.INST.C.E., *Castleknowie, and Town Hall, Dover.*

290 1888. Oct. †Thomas, W. E. C., ASSOC.M.INST.C.E., "*Cringallt,*" *Neath.*

624 1891. Mar. Thompson, George William, ASSOC.M.INST.C.E., 36, *Wood Vale, Forest Hill, S.E.*

454 1889. Feb. Thompson, Thomas William, L.R.C.P., M.R.C.S., D.P.H., M.O.H., *Med. Inspr., Local Government Board, S.W.*

592 1890. June. †Thomson, Gilbert, 75, *Bath Street, Glasgow.*

319 1888. Oct. Thorneycroft, Lieut.-Col., *Tettenhall Towers, Wolverhampton.*

292 1888. Oct. Thornley, J. E., *Lyndon, Bickenhill, Birmingham.*

570 1890. Jan. Thresh, John Clough, M.B., B.S., D.SC., F.I.C., F.C.S., M.O.H., *Chelmsford.*

435 1889. Jan. Thring, Right Hon. Lord, K.C.B., F.R.G.S., 5, *Queen's Gate Gardens, S.W.*

513 1889. July. Thursfield, W. N., M.D., D.P.H., M.O.H., *Shrewsbury.*

407 1888. Dec. Titmas, William, 34, *Grafton Street, W.C.*

685 1892. Feb. ‡Townsend, John Walter, "*Wendreda,*" *Lancaster Road, Wimbledon.*

293 1888. Oct. Travers, William, M.D., F.R.C.S., 2, *Phillimore Gardens, W.*

408 1888. Dec. Trew, J. Fletcher, 12, *Clarence Street, Gloucester,* (22, *Broad Street, Bristol*).

318 1888. Oct. Tyndale, Walter Clifford, ASSOC.M.INST.C.E., *Horse Guards, Whitehall, S.W.*, (*St. Stephen's Road, Ealing*).

496 1889. Mar. Underhill, A. S., M.B., B.A., M.R.C.S., D.P.H., *Great Bridge, Tipton*

294 1888. Oct. Valon, William A., ASSOC.M.INST.C.E., 140, *Temple Chambers, Temple Avenue, E.C.*

689 1892. Mar. Verdon, H. Walter, M.D., F.R.C.S., M.O.H., 47, *Brixton Hill, S.W.*

300 1888. Oct. Wakefield, Miss E. M., *Broughton, Longdon, Rugely.*

303 1888. Oct. Wallace, William, 27A, *Old Bond Street, W.*

596 1890. Oct. †‡Wallis, Arthur Gray, *Care of West of Scotland Sanitary Association,* 75, *St. George's Place, Glasgow.*

304 1888. Oct. Wallis, H. Sowerby, F.R.MET.SOC., 25, *Northwood Road, Highgate, N.*

585 1890. Apr. Wallis, Isabel White, 49, *Clifton Hill, St. John's Wood, N.W.*

706 1892. Apr. Walton, Rienzi G., M.INST.C.E., 2, *Lexham Gardens, Kensington, S.W.*

Reg. No.	Date of Election.	
647	1891. Nov.	WARD, Arthur W., *Lisburn, Merton Road, Southsea.*
664	1891. Dec.	WATSON, John Duncan, ASSOC. M. INST. C. E., *County Buildings, Aberdeen.*
437	1889. Jan.	WELCH, Henry, M.D., B.SC., D.P.H.EDIN., *Shefferlands, Hulton, Lancaster.*
364	1888. Nov.	WELLS, SIR T. Spencer, BART., M.D., F.R.C.S., 3, *Upper Grosvenor Street, W.*
714	1892. Nov.	WETWAN, William Albert, M.R.C.S., L.S.A., *Medical Officer of Health for Bridlington*, 9, *Prospect Street, Bridlington Quay, Yorkshire (East Riding).*
603	1890. Nov.	WHEELER, Charles, 12, *Dovecote Villas, Wood Green.*
655	1891. Nov.	WHITAKER, William, B.A., F.R.S., F.G.S., 33, *East Park Terrace, Southampton*, (28, *Jermyn Street, S.W.*).
409	1888. Dec.	†WHITCOMBE, Arthur, 48 *&* 50, *Howland Street, Fitzroy Square, W.*
305	1888. Oct.	WHITE, William, F.S.A., F.R.I.B.A., 30*a*, *Wimpole Street, W.*
509	1889. Apr.	WIGHTWICK, Fallon Percy, M.B., M.R.C.S., L.R.C.P., D.P.H., *St. John's, Horsleydown, S.E.*
306	1888. Oct.	WILKINSON, W. B., *Northumberland Street, Newcastle-on-Tyne.*
307	1888. Oct.	‡WILKINSON, William, *Town Hall, Salford*, (20, *Aldren Street*).
308	1888. Oct.	WILLIAMS, C. Theodore, M.A., M.D., F.R.C.P., F.R.MET. SOC., 2, *Upper Brook Street, W.*
715	1892. June.	WILLIAMS, Owen, *Surveyor, Aberdare, Glamorgan.*
670	1891. Dec.	WILLIAMS, Roscoe A., M.D., *State Board of Health, Olathe, Kansas, U.S.A.*
562	1889. Dec.	WILLIAMS, William, M.A., M.B., D.P.H.OXON, M.R.C.S., L.S.A., 2, *Southfields, Dolgelly, South Wales.*
734	1892. Oct.	†WILLIAMS, William Iltyd, *Pentregwithel, Abergavenny.*
523	1889. Apr.	WILLIS, George, L.F.P.S.G., M.O.H., *Clifton House, Baillieston, Glasgow.*
712	1892. June.	WILLIS, John, *Frances Road, Windsor.*
309	1888. Oct.	†WILSON, J. B., *Court House, Cockermouth.*
737	1892. Oct.	†WILSON, John Allen, 18, *Rodney Terrace, Cheltenham.*
678	1892. Jan.	WINDLE, Jabez Davenport, M.R.C.S., L.R.C.P., M.O.H., *Chippenham Lodge, Southall.*
310	1888. Oct.	WITHERS, J. B. Mitchell, F.R.I.B.A., 73, *Surrey Street, Sheffield.*
311	1888. Oct.	†‡WITTS, J. W., M.S.E., *Borough Engineer's Office, Leeds.*
312	1888. Oct.	WOOD, Jacob, *Highbury Park, N.*
365	1888. Nov.	WOOD, William, M.D., 99, *Harley Street, W.*
497	1889. Mar.	WOODMAN, John, M.D., F.R.C.S., M.O.H., *Southernhay, Exeter.*

Reg. No. Date of Election.

313 1888. Oct. WOODWARD, Edward Francis, 43, *Southwell Street, Bristol.*

444 1889. Jan. †WORTH, John Edward, ASSOC.M.INST.C.E., F.R.MET.SOC., *Coombes Croft House, High Road, Tottenham.*

314 1888. Oct. WYNDHAM, REV. Francis M., M.A.OXON, *St. Mary of the Angels, Westmoreland Road, Bayswater.*

315 1888. Oct. YUILL, W., ASSOC.M.INST.C.E., 3, *Fenchurch Avenue, E.C.*

ASSOCIATES (ASSOC. SAN. INST.)

‡ Marked thus have passed the Examination of the Institute for Inspectors of Nuisances.

1 1888. Oct. ‡ABRAMS, Henry, 5, *Westmoreland Road, Bromley, Kent.*

630 1892. Sept. ‡ACKERNLEY, Joseph, *Broughton Road, Skipton, York.*

212 1889. Nov. ‡ADAMS, Albert E., *Local Board Offices, Wood Green.*

2 1888. Oct. ‡ADAMS, H. J., 13, *Salcott Road, Wandsworth Common S.W.*

51 1888. Oct. ADAMS, Miss Rose (LADIES' SANITARY ASSOCIATION), 22, *Berners Street, Oxford Street, W.*

658 1892. Nov. ‡ALLEN, Thomas Holtan, *Stumpshaw, Norfolk.*

137 1889. Jan. ‡ALLEN, William Henry, 22, *Moira Street, Cardiff.*

337 1890. Nov. ‡AMOR, Alfred, *Octagon Chambers, Nelson Street, Bath.*

4 1888. Oct. ‡AMOR, Daniel C., "*Beaulieu,*" *The Polygon, Southampton.*

616 1892. Oct. ‡ANDERSON, George Hart, 33, *Borough Road West, Middlesborough.*

176 1889. May. ‡ANDERSON, Tom, 32, *Harrington Street, Hampstead Road, N.W.*

528 1892. Feb. ‡ANDREWS, Daniel James, *Court House, Marylebone.*

314 1890. July. ANNETT, William Fenn, 5, *Church Street, Kensington.*

501 1892. Feb. ‡ANTHONY, Frederick Joseph, 33, *Yattan St., Bromley, E.*

636 1892. Sept. ‡ARMITAGE, Fredk. Lincoln, *Upper Spring Street, Huddersfield, York.*

637 1892. Sept. ‡ARMITAGE, T. Albert, *South Parade, Huddersfield, York.*

389 1891. Apr. ‡ASHDOWN, Thomas, 22, *Charlwood Street, Pimlico, S.W.*

525 1892. Feb. ‡ATHEY, Frederick, 47, *Penge Road, South Norwood.*

609 1892. June. ‡ATKINS, Benjamin, 31, *Russell Street, Leamington Spa.*

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567	1892. May.	‡Atkins, Robert William, 32, *Holmwood Road, South Norwood.*
581	1892. May.	Atkinson, Thomas Appleton, *Sanitary Inspector, Darlington.*
607	1892. June.	Attridge, Henry L., *Sanitary Engineer, Sea Point, Cape Town, South Africa.*
505	1892. Feb.	‡Ayliffe, Charles William Loveless, *Vine Cottage, Ascot.*
200	1889. July.	‡Bailey, William, 74, *Wilmslow Road, Withington, Manchester.*
181	1889. June.	‡Bainton, John, *Scunthorpe, Doncaster.*
168	1889. Apr.	Baker, William, mem. soc. arts, 1, *Chetwynd Road, Lawrence Road, Southsea.*
515	1892. Feb.	‡Baker, William Kirkham, *The Infectious Hospital, Mill Road, Cambridge.*
635	1892. Sept.	‡Baldwin, Parkinson, *Farnhill, Kildwick, via Keighley, Yorkshire.*
244	1890. Feb.	‡Balster, Herbert, *Town Hall, Margate.*
5	1888. Oct.	Bamlett, Adam Carlisle, *Thirsk, Yorkshire.*
106	1889. Jan.	‡Barfoot, James, 100, *Brook Street, Kennington Road, Lambeth, S.E.*
6	1888. Oct.	‡Barron, John, 81, *Landor Road, Stockwell, S.W.*
357	1891. Feb.	‡Bartlett, William John, 50, *Cumming Street, E.C.*
7	1888. Oct.	‡Bascombe, H. C., *Wallasey Local Board, Egremont, Cheshire.*
195	1889. June.	‡Bassett, William Joshua, 16, *Elizabeth Street, Eaton Square, S.W.*
608	1892. June.	‡Bates, Matthew, *Local Board Offices, Bromley, Kent.*
265	1890. Apr.	‡Baxter, Frank E., 374, *Kennington Road, S.E.*
9	1888. Oct.	‡Baxter, John, 374, *Kennington Road, S.E.*
107	1889. Jan.	‡Beck, William Coker, *Hastings.*
479	1891. Dec.	‡Beech, James, *Ivy Cottage, Brownhills, Tunstall.*
182	1889. June.	‡Birch, John Ernest William, 107, *Cobden Road, South Norwood, S.E.*
493	1892. Jan.	Bird, Sidney James, *H. M. Convict Prison, Portland, Dorset.*
287	1890. May.	‡Bird, William Frederick, *The Island, Midsomer Norton.*
313	1890. July.	‡Bishop, William F., 8, *Francis Place, Nine Tree Hill, Bristol.*
10	1888. Oct.	‡Black, Andrew E., 57, *Academy Street, Inverness, N.B.*
404	1891. May.	‡Blackman, Henry, *Catsfield, Battle.*
99	1888. Dec.	Blake, E. T., m.d., 47, *Seymour St., Hyde Park, W.*
375	1891. Mar.	‡Blake, H. K., 1, *Victoria Road, Stroud Green, N.*
193	1889. June.	Bland, William, 420, *Liverpool Road, Patricroft.*
631	1892. Sept.	‡Bolton, Joseph, 15, *Cambridge Terrace, Otley, York.*
231	1890. Jan.	‡Bond, William Henry, *St. Giles Board of Works, Holborn, W.C.*
12	1888. Oct.	‡Bostel, G. Stanford, 18, *Duke Street, Brighton.*

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392 1891. Apr. ‡Bourne, Edward, 256, *High Street, Cheltenham.*
109 1889. Jan. ‡Bovey, William T., *Acton, W.*
208 1889. July. ‡Bowyer, Harry David, *Park Street, Slough.*
13 1888. Oct. ‡Boyce, W., 117, *High Street, Poplar, E.*
14 1888. Oct. Boyd, Richard Wade, 105, *New Bond Street, W.*
382 1891. Mar. ‡Braley, Francis, 18, *Woodbine Avenue, Leicester.*
610 1892. June. ‡Bramham, William, *Fern Cottage, Market Street, Clay Cross.*
15 1888. Oct. Breeze, John, *Poynton Lodge, Wellington, Salop.*
358 1891. Feb. ‡Brindle, Thomas, 12, *Ashfield Road, Chorley.*
16 1888. Oct. Broad, Clement B., *Stamford Brook Lodge, Ravenscourt Park, W.*
390 1891. Apr. ‡Broadhead, S., 24, *St. James' Street, Humberstone Gate, Leicester.*
334 1890. Nov. ‡Brook, John, *Albany Place, Stratford-on-Avon.*
335 1890. Nov. Broughton, Thomas, *Garston, near Liverpool.*
391 1891. Apr. ‡Brown, George William, Serg.-Maj. R.E., 3, *Marle Hill Villas, Cheltenham.*
359 1891. Feb. ‡Brown, John, 8, *Paddock, Whitby.*
579 1892. May. ‡Brown, Reginald, *Local Board, Office, Ealing, Middlesex.*
578 1892. May. ‡Brown, Robert Frederick, 130, *Devonshire Street, Mile End.*
591 1892. May. ‡Brown, Robert, Jun., 44, *St. Ann's Hill, Wandsworth.*
17 1888. Oct. ‡Brown, R. Railston, 1, *Blenheim Terrace, Bridlington Quay, Yorkshire.*
18 1888. Oct. ‡Brown, W. E., 19, *Havelock Road, Hastings.*
226 1890. Jan. ‡Bryan, George John, 4, *South Norwood Hill, S.E.*
486 1892. Jan. ‡Bryan, Joseph James, 27, *Oxford Street, Old Trafford, Manchester.*
415 1891. June. ‡Bubb, John Thomas, 1, *James's Parade, Bristol.*
19 1888. Oct. Buchan, W. Paton, *Fairyknowe, Cambuslang, Lanarkshire, N.B.*
20 1888. Oct. Buckeridge, Walter, 5, *Alexander Street, Westbourne Park, W.*
21 1888. Oct. ‡Bugler, W. J., *Alpha House, Putney.*
104 1888. Dec. Burn, Robert G. N., 24, *Charing Cross, S.W.*
22 1888. Oct. Burroughs, S. M., *Snow Hill Buildings, E.C.*
210 1889. Oct. ‡Burscough, Frederick Peter, 42, *Belmont Avenue, Blackpool.*
521 1892. Feb. ‡Burslam, Randle, *Congleton, Cheshire.*
393 1891. Apr. ‡Burton, W. H., 59, *Avenue Road, North Finchley.*
592 1892. May. ‡Butcher, Charles Ernest, 17, *Circus Road, St. John's Wood, N.W.*
178 1889. May. ‡Butland, R. J., *Vestry Hall, Mount Street, W.*
380 1891. Mar. ‡Butler, Walter, *Fareham, Hants.*
267 1890. Apr. ‡Butterworth, Arthur, *Board of Works, Maxey Road, Plumstead.*
142 1889. Feb. ‡Buxton, Anthony, *Carisbroke, Isle of Wight.*

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245 1890. Feb. ‡Callaway, Albert Henry, *Grosvenor Villa Evesham Place, Stratford-on-Avon.*

654 1892. Oct. ‡Cannell, Charles Stephen, 32, *Knowsley Road, Magdalen Road, Norwich.*

420 1891. June. ‡Carter, Alfred, 71, *Leighton Road, Kentish Town.*

429 1891. July. ‡Cary, Aquilla S., 1, *Lily Villas, New Southgate.*

593 1892. May. ‡Cass, Robert William, 27, *Park Avenue, Church Lane, Pudsey.*

23 1888. Oct. ‡Catten, Joseph H., 32, *Exeter Street, Sloane Street, S.W.*

500 1892. Feb. ‡Cave, James, *Town Hall, Kensington.*

664 1892. Dec. ‡Chalk, Joseph, *Waterworks Engineer's Office, Southampton.*

458 1891. Nov. Challoner, William, *Blackpool, Lancaster.*

628 1892. Sept. ‡Chambers, Frederick, *Local Board Offices, Goole, Yorkshire.*

524 1892. Feb. ‡Chambers, Matthew, *Millhouses, Sheffield.*

169 1889. Apr. ‡Chaney, William H., 36, *Essex Street, Strand.*

535 1892. Mar. ‡Chappell, William, 96, *Grove Road, Holloway.*

453 1891. Nov. ‡Cheshire, Alfred, 64, *Church Street, Rugeley.*

490 1892. Jan. ‡Clarke, Robert Edwyn, 5, *Gibson Square, Islington, N.*

25 1888. Oct. ‡Clarkson, Joseph, *Churchfield Terrace, Batley, Yorks.*

110 1889. Jan. ‡Clayton, Edward, *Mansfield, Notts.*

294 1890. June. ‡Clifton, Henry Chas., 50, *Porchester Road, Bayswater.*

26 1888. Oct. ‡Cobham, C., *The Shrubbery, Gravesend.*

27 1888. Oct. Cobham, G. R., 3, *Edwin Street, Gravesend.*

266 1890. Apr. ‡Cockburn, Henry Mace, *Town Hall, Spa Road, S.E.*

316 1891. Jan. ‡Cole, A. C., 21, *West Street, Dorking.*

520 1892. Feb. ‡Coles, John Thomas, 18, *St. George's Road, Winsford.*

433 1891. July. ‡Collins, Henry Beale, 16, *Little Grosvenor Street, W.*

483 1891. Dec. ‡Collyer, J., *Uttoxeter, Stafford.*

556 1892. Apr. ‡Cook, Alfred, 103, *Commercial Street, E.*

464 1891. Nov. ‡Cook, James, *Warton, near Carnforth.*

598 1892. June. ‡Cook, William George, *Weatherall Cottage, Well Road, Hampstead.*

339 1890. Dec. ‡Cook, William Gough, "*Enmore,*" *The Grove, Clapham Road, S.W.*

114 1889. Feb. ‡Cooper, William George, *Sanitary Inspector, Bournemouth.*

229 1890. Jan. ‡Copestick, George Christopher, 47, *Bateman Street, Derby.*

220 1890. Jan. ‡Corbett, Richard Lawrence, *Oakengates, Salop.*

533 1892. Mar. ‡Corby, Thomas, 13, *Rochester Road, Camden Road, N.W.*

135 1889. Jan. ‡Cordon, Robert Curtis, *Hillside Cottage, Duffield, Derby.*

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411 1891. June. ‡Corp, James, 16, *Harrington Square, N.W.*
164 1889. Mar. ‡Cottle, Arthur Thomas, *Selly Oak, Near Birmingham.*
262 1890. Mar. Court, Thomas Henry, 103, *King's Road, Peckham*, (140, *Tanners Hill, Deptford*).
443 1891. Oct. ‡Cowderoy, John Tatem, *Kidderminster, Worcester.*
133 1889. Jan. ‡Cowper, Joseph, 181, *Brixton Road.*
345 1891. Jan. ‡Coxill, George E., *Vestry Hall, Cable Street, E.*
488 1892. Jan. ‡Crabbe, W. G., 44, *St. Lawrence Road, Brixton.*
417 1891. June. ‡Crane, Joseph, 93, *Trafalgar Road, Gorleston, Great Yarmouth.*
656 1892. Nov. ‡Crane, Stephen, 8, *Dighton Road, Wandsworth, Surrey.*
354 1891. Feb. ‡Crane, William Henry, 14, *Colonial Street, Hull.*
301 1890. June. ‡Crocker, Thomas William, *Borough of West Ham.*
199 1889. June. ‡Crockwell, George E., 14, *Church Street, Ilfracombe.*
590 1892. May. ‡Crofts, Thomas John, 50, *Central Street, Landport, Portsmouth.*
29 1888. Oct. ‡Croghan, Thomas Andrew, 37, *Devonshire Gardens, Buxton.*
383 1891. Mar. ‡Cronk, Wm. Robert, *Cranford House, Cranford, Hounslow.*
247 1890. Feb. ‡Crosse, Hammond William, *St. Mary's Cottage, Putney.*
218 1890. Feb. ‡Crossley, James, 1, *Maurice Street, Bolton Road, Pendleton.*
216 1890. Jan. ‡Crowther, William Christopher, 51, *Hind Street, Stockton-on-Tees.*
573 1892. May. ‡Cruden, John, *Berwick-upon-Tweed.*
355 1891. Feb. ‡Culver, Thomas Henry, 34, *Bradstone Avenue, Folkestone, Kent.*
601 1892. June. ‡Currie, Thomas, *Marshall Cottage, Hawkhill, Ayr.*
426 1891. June. ‡Dale, Duncan, 312, *Camberwell New Road, S.E.*
477 1891. Dec. Dalton, George, 15, *Histon Road, Cambridge.*
184 1889. June. ‡Daltry, John, *Sanitary Inspector, Wellington, Salop.*
612 1892. June. ‡Dane, Samuel, *Bird Nest Cottage, Primrose Lane, Glossop.*
30 1888. Oct. ‡Darley, George, 49, *St. Marks Street, Woodhouse, Leeds.*
561 1892. May. ‡David, Philip, 23, *North Luton Place, Cardiff.*
543 1892. Oct. ‡Davies, Dan, *Ferndale, Rhondda Valley, Glamorgan.*
292 1890. May. ‡Davies, T. Lane, 1, *Albert Square, E.*
562 1892. May. ‡Dawson, Edward Howard, 41, *Market Street, Lancaster.*
425 1891. June. ‡Dawson, John Marshall, 93, *Malpas Road, Brockley.*
300 1890. June. ‡Dawson, William, 6, *Brooklands Road, Birkenhead.*
254 1890. Mar. ‡Dean, Samuel Saunders, *Hugglescote, Ashby-de-la-Zouch.*
312 1890. June. ‡Dee, Thomas George, 17, *Grosvenor Road, S.W.*
647 1892. Oct. ‡Denham, Hodgson, *Aberford, near Leeds.*

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100	1888. Dec.	Densham, Charles A., 42, *Wellington Road, St. John's Wood, N.W.*
621	1892. July.	‡Dewhirst, James, *Sanitary Inspector's Office, Plymouth.*
270	1890. May.	‡Dick, William, *Kirknewton, Midlothian.*
482	1891. Dec.	‡Docking, Frederick Reynolds, 56, *George Street, Croydon.*
655	1892. Oct.	‡Dodgson, William, *Cononley, York.*
234	1890. Jan.	Dover, John Henry, 13, *King Street, Kensington Square, W.*
454	1891. Nov.	‡Dowsing, Alfred, 2, *Mawney's Villas, Romford.*
111	1889. Jan.	‡Drake, W. Medley, *Kirkheaton, Huddersfield.*
196	1889. June.	‡Duck, Albert George, 211, *Tooley Street, Horsleydown, S.E.*
241	1890. Feb.	‡Dunbar, David.
450	1891. Nov.	‡Duthie, Alexander, 93, *High Street, Brechin, N.B.*
145	1889. Feb.	‡Dyer, Samuel, 3, *Wellington Road, Bridlington Quay.*
408	1891. June.	‡Dyke, Alfred William, *St. John's Wharf, Wandsworth, Bridge, Fulham.*
112	1889. Jan.	‡Dyson, John Henry, *Park Terrace, Thornhill, near Dewsbury.*
412	1891. June.	‡Earwicker, John Chas., *Cambridge House, Drayton Place, Croydon, S.W.*
469	1891. Nov.	‡Eccles, William Henry, 98, *Kay Street, Darwen.*
113	1889. Jan.	‡Edmonds, William H., *Vestry Hall, Hampstead, N.W.*
333	1890. Nov.	Edwards, John, 16, *Gladstone Street, St. George's Rd., S.E.*
596	1892. June.	‡Ellis, Stanley, 28, *Chertsey Street, Guildford.*
31	1888. Oct.	‡Emptage, Daniel, *Dane Hill Sanitary Works, Margate.*
32	1888. Oct.	‡Evans, John Evan, 37, *Anchor Street, Southwark Park Road, S.E.*
563	1892. May.	‡Evans, John Isaac, 11, *Blanche Street, Cae Harris, Dowlais.*
290	1890. May.	‡Evington, Charles William, 12, *Bridlington Street. Hull.*
33	1888. Oct.	‡Fairchild, Samuel C. G., 569, *Wandsworth Road, Clapham, S.W.*
353	1891. Feb.	‡Fairey, Alfred Isaac, 5, *Tavistock Street, Covent Garden.*
252	1890. Mar.	Finch, William, 44, *Mason Street, Kingston-upon-Hull.*
114	1889. Jan.	‡Fincher, John Gazeley, *Aldershot.*
572	1892. May.	‡Fisher, Robert, 141, *Greenwich Road, Greenwich, S.E.*
476	1891. Nov.	‡Foad, Cephas, *Board of Works*, 117, *High Street, Poplar, E.*
297	1890. June.	‡Folland, John Percy, 22, *Liverpool Street, King's Cross.*
35	1888. Oct.	‡Fordham, Wm. Francis, *Hampton House, High Road, Kilburn.*

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281 1890. May. ‡FORRESTER, William, *Staplehurst, Kent.*

614 1892. June. ‡FOSTER, Edward, 29, *St. Maur Road, Fulham, S.W.*

36 1888. Oct. FRANCE, T. W. Chapman, 36, *Bristol Road, Edgbaston.*

218 1890. Jan. ‡FULCHER, George, *Rural Sanitary District, Rugby.*

94 1888. Oct. GAIRDNER, PROF. W. T., M.D., LL.D., *The University, Glasgow.*

96 1888. Nov. ‡GARDNER, C. T., *Town Hall, Worthing.*

37 1888. Oct. ‡GARLAND, Wm., 12, *Higher Maudlin Street, Barnstaple.*

613 1892. June. ‡GARNHAM, Albert Edward, *Beulah Hill, Norwood, S.E.*

38 1888. Oct. GASS, John Bradshaw, F.R.I.B.A., 19, *Silverwell Street, Bolton.*

186 1889. June. ‡GATHERCOLE, William Henry Joseph, *Sanitary Inspector, Guildhall, E.C.*

544 1892. Mar. ‡GERRARD, John, 43, *Woolton St., Woolton, Liverpool.*

260 1890. Mar. ‡GIBSON, John, *Health Offices, North Church Street, Sheffield.*

158 1889. Mar. ‡GILBEART, John Joseph, 11 & 12, *Little Chester Street, Belgrave Square, W.*

217 1890. Jan. ‡GILLIES, Neill, *Lochgilphead, Argyllshire, N.B.*

418 1891. June. ‡GILLESPIE, REV. Charles George Knox, 2, *Darwin Terrace, Derby.*

394 1891. April. ‡GODSALL, Henry John, *Park Road, Saltley, Birmingham.*

604 1892. June. ‡GOLDER, Thomas Collings, 5, *Connaught Road, Folkestone.*

503 1892. Feb. ‡GOODMAN, Herbert, 4, *Clapton Common, N.E.*

39 1888. Oct. ‡GOODWYN, Arthur Ayde, 34, *Church Road, Richmond, Surrey.*

519 1892. Feb. ‡GORNIOT, Thomas Arthur, 98, *Bingfield Street, York Road, King's Cross.*

360 1891. Feb. ‡GOUGH, Joseph, 7, *Malvern Terrace, St. Paul's Road, Tottenham.*

474 1891. Nov. ‡GRANT, Alexander, *Town Hall, Chelsea.*

115 1889. Jan. ‡GRANT, Walter, 18, *Gildredge Road, Eastbourne.*

332 1890. Nov. ‡GRAVES, Matthew Dodgson, 7½, *College Street, York.*

438 1891. July. ‡GREEN, Edward Albert, 16, *Rock Street, Bridgehouses, Sheffield.*

361 1891. Feb. ‡GREEN, William, 6, *Meredith Street, Clerkenwell, E.C.*

187 1889. June. ‡GREENWELL, Allan, *Surveyor's Office, Frome.*

40 1888. Oct. GRIBBLE, Miss Sarah C., 11, *Willswood Park, Torquay.*

530 1892. Mar. ‡GRIFFIN, George Frederick Augustus, *Nottingham Road, Mansfield.*

362 1891. Feb. ‡GRIGG, William Henry, 2, *Acford Road, South Fulham, S.W.*

302 1890. June. GRINHAM, Philip Boys, *Tichborne Down, Alresford.*

419 1891. June. ‡GRIVELL, Elias James, *Storrington, Sussex.*

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309 1890. June. ‡Groom, William Edwin, 117, *Wells Street, Camberwell.*

41 1888. Oct. ‡Gunn, Alexander, 118, *King Street, Aberdeen.*

230 1890. Jan. ‡Hall, George Berringer, F.G.S., 10, *Waldemar Avenue, Fulham Road.*

653 1892. Oct. ‡Hall, John, *Poundfield, Stonehouse, Gloucester.*

629 1892. Sept. ‡Hall, Thomas John, 17, *Regent Street, Barnsley, Yorkshire.*

624 1892. Sept. ‡Hammond, William Henry, *South Parade, Horbury, near Wakefield, Yorkshire.*

406 1891. June. ‡Harper, Frank, 39, *Derby Road, Northampton.*

197 1889. June. ‡Harrison, George, *Thurnly, Leicester.*

376 1891. Mar. ‡Harrison, Wm. Henry, *Health Offices, Sheffield.*

42 1888. Oct. ‡Harrison, Wm. L., 7, *Dock Street, Hull.*

43 1888. Oct. ‡Hart, W. S., 29, *Coley Hill, Reading.*

377 1891. Mar. ‡Hartnoll, Francis, 49, *St. Paul's Road, Burdett Road, E.*

418 1891. Oct. ‡Hatton, Chas., 14, *Merton Road, Wandsworth, S.W.*

219 1890. Jan. ‡Hay, Alexander, 56, *George Square, Glasgow.*

44 1888. Oct. ‡Head, Robert H., 7, *Upper Baker Street, N.W.*

465 1891. Nov. ‡Heaps, William, Junr., 28, *Parker Street, Chorley, Lancashire.*

45 1888. Oct. Hearn, Walter, 62, *Grove Park Terrace, Grove Park, Chiswick, W.*, (27, *Mecklenburgh Square, W.C.*).

46 1888. Oct. ‡Hearne, William, *Buenos Ayres.*

534 1892. Mar. ‡Hebden, Joseph Henry, 1, *Eton Street, Hessle Road. Hull.*

192 1889. June. ‡Helsdon, Horace, 14, *St. Edmunds Terrace, Primrose Hill, N.W.*

577 1892. May. ‡Henley, Amos S., *Camberwell Workhouse, Willow Brook Road, Peckham.*

363 1891. Feb. ‡Hennen, Alfred, 37, *Joseph Street, Gosport.*

467 1891. Nov. ‡Herbert, Harry, 10, *Boughton Street, Sunderland.*

548 1892. Mar. ‡High, George Fred., 28, *Clifden Road, Lower Clapton.*

259 1890. Mar. ‡Hills, Arthur Reginald, 24, *Harley Street, Bow, E.*

101 1888. Dec. ‡Hobbs, W. F., 36, *Melbourne Street, Stalybridge.*

255 1890. Mar. ‡Hodges, Albert, 57, *Hall Street, Blakenhall, Wolverhampton.*

282 1890. May. ‡Holland, Percy, *Fairstead Cottage, Newmarket.*

638 1892. Sept. ‡Holmes, John Edward, *North Collingham, Newark.*

188 1889. June. ‡Holmes, William, 43, *Thornhill Street, Wakefield, Yorkshire.*

194 1889. June. ‡Hooper, Thomas Rowland, *Redhill, Surrey.*

222 1890. Jan. ‡Hooper, William, 8, *Lucas Road, St. John's Road, Penge, S.E.*

510 1892. Feb. ‡Horlock, Charles William, *Little Orsted, Uckfield.*

47 1888. Oct. Horncastle, Henry, *Ash Lawn, Hamlet Road, Upper Norwood, S.E.*

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462	1891. Nov.	‡HORNER, Benjamin Roper, 2, *St. Stephen's Terrace, West Bowling, Bradford, Yorks.*
49	1888. Oct.	‡HORROCKS, Joseph, 10, *Union Street, Southport.*
461	1891. Nov.	‡HORSMAN, Charles Edwin, 8, *Bedford Square, Bishopwearmouth, Sunderland.*
494	1892. Feb.	‡HORTON, Richard, 8, *Orford Street, Chelsea, S.W.*
586	1892. May.	‡HORTON, William, 22, *Halsey Street, Chelsea.*
116	1889. Jan.	‡HOUGHTON, Robert Alfred, 5, *Merton Hall Road, Wimbledon.*
331	1890. Nov.	‡HUGHES, Edward J., 102, *Camden Street, Birkenhead.*
475	1891. Nov.	‡HUGHES, Walter, *Thompson Street, Bilston.*
661	1892. Nov.	‡HUNT, William Edward, 1, *Ashmead Road, St. John's, S.E., Kent.*
560	1892. May.	‡HUTCHINGS, William Arthur, 15, *St. John's Park Terrace, Winchester.*
663	1892. Nov.	ILES, Alfred Robert, *Sanitary Engineer*, 102, *Flaxman Road, Camberwell.*
224	1890. Jan.	‡IMRIE, Henry William, 28, *Parry Place, Plumstead.*
239	1890. Feb.	‡INGRAM, William Jones, *Goldsworth Road, Woking.*
484	1891. Dec.	‡INSKIP, Frederick Thomas, *Delhorne, Stoke-on-Trent.*
516	1892. Mar.	‡IRVING, William, *Local Board, Wigton.*
611	1892. June.	‡JACKLING, William, *Maidstone.*
251	1890. Feb.	JACOB, Oswald, *Sanitary Inspector, Feltham, Middlesex.*
347	1891. Feb.	‡JACKSON, Henry James, 4, *Corn Street, Witney.*
415	1891. Oct.	‡JACKSON, William, 335, *Glossop Road, Sheffield.*
414	1891. Oct.	‡JARVEY, George, *Town Hall, Salford.*
147	1889. Feb.	‡JASPER, Robert Wevill, *Withersfield Road, Haverhill, Suffolk.*
235	1890. Jan.	‡JELLIS, John, 188, *Uttoxeter Old Road, Derby.*
207	1889. July.	‡JENNER, Richard Messenger, *Parade Road, Sandgate.*
374	1891. Feb.	‡JOHNSON, H. Watts,
286	1890. May.	‡JOHNSON, John William, 785, *Commercial Road, Limehouse, E.*
330	1890. Nov.	‡JOHNSON, Joseph Edward, *Town Hall, Hull.*
455	1891. Nov.	‡JOHNSON, Matthew, 31, *Palmer Street, Jarrow.*
351	1891. Feb.	‡JOHNSON, Stafford, 3, *Percy Road, Leytonstone.*
396	1891. Apr.	‡JONES, Charles Bristow, *Town Hall, Fulham.*
299	1890. June.	JONES, John, 40, *Sydney Street, Chelsea.*
329	1890. Nov.	‡JONES, Julius Morris Wilson, 27, *Mornington Road, Bow, E.*
189	1889. June.	‡JONES, William, *Cemlyn, Dolgelly, Merioneth.*
258	1890. Mar.	‡JOURS, William, *Gateshead.*
312	1890. Dec.	‡JURY, H. A., *North-East Lodge, Chelsea Bridge, Grosvenor Road, Pimlico, S.W.*
50	1888. Oct.	‡KEAL, J., *Southview Hill Road, Sutton, Surrey.*
581	1892. May.	‡KELF, Charles Harvey, *The Gardens, South Villa, Inner Circle, Regent's Park, N.W.*
51	1888. Oct.	‡KEMSLEY, Jesse, 60, *Chesterfield Grove, East Dulwich.*

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529 1892. Mar. ‡Kennedy, Daniel, 19, *Tremlett Grove, Junction Road, N.*
407 1891. June. ‡Kershaw, Edward Baxter, 115, *Wellfield Road, Streatham.*
52 1888. Oct. ‡Kiell, John, 103, *High Street, Barnstaple.*
582 1892. May. ‡Kilgallin, Charles J., 108, *Charing Cross Road, W.*
439 1891. July. ‡King, Albert S. W., 31, *Mervan Road, Brixton, S.W.*
149 1889. Feb. ‡King, Frederick William, *Heybridge, Maldon, Essex.*
318 1891. Feb. ‡Kirk, John Wright, *Ivy Villa, Park Road, Plumstead.*
570 1892. May. ‡Kirk, William Hugh, *Town Hall, Newcastle-upon-Tyne.*
53 1888. Oct. Kite, Charles, 31, *Barronsmere Road, East Finchley.*
274 1890. May. ‡Knight, Robert, Junr., *Dunfermline, Fife.*
150 1889. Feb. ‡Knight, William Henry, "*Dulce Domun,*" *Gisburn Road, Hornsey, N.*
568 1892. May. Knowles, James Edward, 9, *System Street, Cardiff.*
615 1892. June. ‡Knox, Charles Geary, 60, *Lordship Road, Stoke Newington.*
603 1892. June. ‡Lamport, Miss Ethel Frances, 55, *Burton Crescent, W.C.*
190 1889. June. ‡Lander, James, 19, *Millbank Street, Westminster.*
55 1888. Oct. ‡Lapworth, J., *Vestry Hall, Bethnal Green, E.*
214 1889. Nov. ‡Laurie, John, 14, *Poplars Avenue, Willesden Green.*
459 1891. Nov. ‡Lear, Charles F. E., *Alverstoke, Hampshire.*
131 1889. Jan. ‡Lear, James Walter, 122, *Southgate Road, N.*
159 1889. Mar. ‡Lee, James, 28, *Franchise Street, Rochdale.*
56 1888. Oct. ‡Legg, S. C., 117, *Powerscroft Road, Lower Clapton, N.E.*
516 1892. Feb. ‡Leigh, Frederick George, *The Sanatorium, Whiston, near Prescot.*
102 1888. Dec. ‡Lennox-Clarke, A.
364 1891. Feb. ‡Lewis, Charles, *Witham, Essex.*
117 1889. Jan. ‡Lewis, Arthur, *Isham, Wellingborough.*
57 1888. Oct. ‡Lightfoot, Thos., 80, *Vincent Square, Westminster.*
291 1890. May. ‡Lightfoot, William Charles, 86, *Harbut Road, St. John's Hill, New Wandsworth, S.W.*
236 1890. Jan. ‡Lilly, William Gent, 5, *Whitcomb Street, W.C.*
519 1892. Mar. Lindley, Joseph, *Cliffe Villa, Staniclifie, Dewsbury.*
349 1891. Feb. ‡Liscombe, Charles F., 24, *Bishop Street, Bristol.*
328 1890. Nov. ‡Little, William, *Health Office, North Church Street, Sheffield.*
435 1891. July. ‡Lloyd, Christopher, 2, *St. Mark's Terrace, New Brompton, Kent.*
616 1892. June. ‡Loasby, Frederick W., 28, *Millman Street, Bedford Row, W.C.*
256 1890. Mar. ‡Lock, G. H., 64, *Richards Terrace, Roath, Cardiff.*
437 1891. July. ‡Locke, Walter Richard, *Bedford House, Aylesbury.*
311 1891. Jan. Longsdon, Ernest M., *Surveyor, Town Hall, Bakewell.*

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468 1891. Nov. ‡Lowry, John, *Bradmore, Wolverhampton.*

485 1892. Jan. ‡Lowry, Thomas Augustus, 6, *Darlington Street, Wolverhampton.*

118 1889. Jan. ‡Lukes, Arthur Henry, *Town Hall, Gravesend.*

327 1890. Nov. ‡Lund, Clifton, 9, *Bridge Street, Southport.*

58 1888. Oct. ‡Lund, Jeremiah, *St. James's Vestry, Piccadilly.*

623 1892. July. ‡Lyon, James Joseph, 6, *Rice Lane, Walton-on-the-Hill, Liverpool.*

61 1888. Oct. MacIntosh, James, 38, *Langham Street, W.*

203 1889. July. Mackay, George Archibald D., *Inspector of Cleansing, Edinburgh.*

171 1889. Apr. Mackay, James John, 186, *Kensal Road, W.*

237 1890. Feb. ‡Maclennan, John, *Carnock House, Carnock, Dunfermline.*

471 1891. Nov. ‡Madin, William B., *Town Hall, Leek.*

421 1891. June. ‡Mager, Frederick Walter, *Rural Sanitary Authority, Durngate Street, Dorchester.*

272 1890. May. ‡Malcolm, Alfred, *Clayton, near Manchester.*

496 1892. Feb. ‡Malvern, Thomas, *Winchcombe Street, Cheltenham.*

457 1891. Nov. ‡Marsden, William Edward, 13, *Springfield Street, Darwen.*

588 1892. May. ‡Martin, Alexander William, 3, *Plumstead Road, Woolwich.*

518 1892. Feb. ‡Martin, Robert, 17, *Wawne Street, Spring Bank, Hull.*

412 1891. Oct. ‡Martin, William, Junr., *Glenburn, Carluke, N.B.*

398 1891. Apr. ‡Mason, Frederick William, 22, *Main Avenue, Bush Hill Park, Enfield.*

264 1890. Apr. Mason, Jonathan, 1, *Grove Terrace, Grove Road, Leytonstone.*

365 1891. Feb. ‡Mason, William Allinson, *Shildon, near Darlington.*

59 1888. Oct. ‡Mathias, H. D., 40, *Southdown Road, Liverpool.*

509 1892. Feb. ‡Matthews, Frederick, *Kedleston, Derby.*

373 1891. Feb. ‡Matthews, William, *Kedleston, Derby.*

523 1892. Feb. ‡Maxwell, William Henry, *Victoria House, Locksbrook, Bath.*

386 1891. Mar. ‡Mayne John William, *Wimbledon, Surrey.*

151 1889. Feb. ‡May, William H., *Inspector's Office, Guildhall, E.C.*

60 1888. Oct. ‡McDonald, A. L., 37, *George Street, Gipsy Hill, S.E.*

625 1892. Sept. ‡Meadows, John W., 52, *Camden Street, North Shields, Northumberland.*

644 1892. Oct. ‡Meazey, Thomas, 1, *Stanwell Road, Penarth.*

103 1888. Dec. Merrill, John, *Albany Road, Sheffield.*

538 1892. Mar. ‡Middleton, H., 19, *Broadley Terrace, Blandford Square, W.*

138 1889. Jan. ‡Millard, William David, 1, *Elswick Villas, Ramsgate.*

594 1892. June. ‡Miller, Frederick William, 137, *Salcott Road, Clapham Common, S.W.*

447 1891. Oct. ‡Miller, Henry, *The Wilderness, Bracondale, Norwich.*

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499 1892. Feb. ‡MILLS, Joshua George, *North Road, West Kirby, Chester.*
403 1891. Apr. ‡MILLS, Walter Shephard, 38, *Chaplin Road, Willesden Green, N.W.*
366 1891. Feb. ‡MILNE, George, *County Buildings, Elgin.*
432 1891. July. ‡MILNER, Walter, 40, *Sackville Street, W.*
315 1890. Oct. ‡MILNER, William, 18, *St. Paul's Road, Preston.*
397 1891. Apr. ‡MINERS, Richard Eustace, *Board of Works, Poplar, E.*
62 1888. Oct. ‡MINTY, Samuel, *The Triangle, Bournemouth.*
381 1891. Mar. ‡MISSELBROOK, G. T., 1, *Lilley Villas, Hartlands Road, Fareham, Hants.*
640 1892. Sept. MITCHELL, Charles Frederick, 92, *Albert Street, Regent's Park, N.W., and The Polytechnic, Regent's Street, W.*
219 1890. Feb. MITCHELL, Edward, 25, *St. Saviour's Road, Croydon.*
385 1891. Mar. MITCHENER, Frederick Harry, 4, *Charles Street, Oxford Road, Islington.*
63 1888. Oct. MOLINEUX, Walter Frank Yate, *Shifnal, Salop.*
308 1890. June. ‡MOODY, Henry Fred, 26, *Cavendish Street, Gt. Grimsby.*
350 1891. Feb. ‡MOORE, Arthur George, *Superintendent of Casual Wards, Lower Road, Rotherhithe, E.C.*
619 1892. July. ‡MORRISON, John William, *Town Hall, Salford, Lancaster.*
420 1891. Apr. ‡MOSLEY, Abraham, *care of E. Law, County Surveyor, Northampton.*
480 1891. Dec. ‡MOSS, Samuel, *Williamson Street, Tunstall.*
495 1892. Feb. ‡MUNRO, Andrew John, *Churchbury House, Churchbury Lane. Enfield.*
566 1892. May. NAYLER, Edward, 140, *Lake Road, Landport, Portsmouth.*
201 1889. July. ‡NETTLETON, Charles William, 16, *Winchester Terrace, Westminster, S.W.*
585 1892. May. ‡NEWNHAM, Frank George, 14, *South Norwood Hill, S.E.*
617 1892. July. NEWSOME, Arthur, *Architect's Assistant, Middlesbrough-on-Tees, York.*
575 1892. May. NEWSON, George John, 25, *Gertrude Street, West Brompton.*
384 1891. Mar. ‡NICHOLAS, David, 256, *Essex Road, Canonbury, N.*
497 1892. Feb. ‡NORMAN, Ernest William, 4, *Dawes Road, Forest Gate, E.*
105 1888. Dec. NORRIS, Joseph, *Sunningdale, Surrey.*
257 1890. Mar. ‡NORRISH, John Thomas, 9, *Cuthbert Road, Brighton.*
285 1890. May. ‡NURCOMBE, Benjamin, 1, *Jasmine Terrace, Wurtemberg Street, Clapham.*
295 1890. June. ‡NUTLEY, Charles Vernon, 11, *Dalling Road, Hammersmith.*
317 1890. Oct. ‡OLIVER, G., 14, *St. John's Road, Waterloo, Liverpool.*
160 1889. Mar. ‡OLLETT, John Henry, *Sanitary Inspector, Eastbourne.*

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619	1892. Oct.	‡Orchardson, Robert, 2, *Manor Place, Ospringe, Faversham.*
213	1889. Nov.	Ord, James, 11, *Portman Street, W.*, (41, *Upper George Street, W.*).
522	1892. Feb.	‡Orrell, Thomas, *Carr Cottage, Threlkeld, Keswick.*
639	1892. Sept.	‡Osborne, Walter, 13, *Third Street, Bensham, Gateshead.*
466	1891. Nov.	‡Outram, Mason, 35, *Stafford Street, Derby.*
64	1888. Oct.	Palliser, Christopher, *Northallerton.*
622	1892. July.	‡Palmer, James, 35, *King William Street, Greenwich, Kent.*
650	1892. Oct.	‡Pank, Richard Arnold, *St. Andrew's, Norwich.*
409	1891. June.	‡Paramor, Robert Walter, 16, *Randolph Gardens, Dover.*
277	1890. May.	‡Parham, John, Junr., 14, *Almack Road, Clapton Park, Hackney.*
478	1891. Dec.	Parkinson, Herbert William, 11, *Gloucester Road, South Kensington.*
211	1889. Oct.	‡Parsons, William, *St. Luke's Vestry Hall, City Road, E.C.*
288	1890. May.	‡Pattison, William Phillip, *White House, Benwell, Newcastle-on-Tyne.*
414	1891. June.	‡Peake, Thomas Jones, 61, *Wybunbury Road, Willaston, Nantwich.*
427	1891. June.	Pearce, Frederick James, *Borough Surveyor's Office, Kingston-on-Thames.*
66	1888. Oct.	‡Pearson, John, *Sanitary Inspector, Grace Hill, Folkestone.*
97	1888. Nov.	‡Perry, Arthur, 45, *Townshend Road, St. John's Wood.*
191	1889. June.	‡Perry, Walter Harold, 10, *Berkeley Avenue, Bishopston, Bristol.*
153	1889. Feb.	‡Pettit, George Mackness, *Frederick Villa, Padua Road, Penge, S.E.*
289	1890. May.	‡Phillips, Henry, 56, *Campden Street, Campden Hill.*
627	1892. Sept.	‡Pidwell, Engall Thomas, 13, *Kelvin Grove, Sydenham, Kent.*
430	1891. July.	‡Pilbeam, Francis Newcastle, 28, *Rosaville Road, Fulham.*
416	1891. Oct.	‡Pool, Frederick, *Sanitary Department, Town Hall, Manchester.*
233	1890. Jan.	Poole, James, 2, *Trafalgar Place, Kensington.*
67	1888. Oct.	‡Potter, Ben, *Heathfield House, Broadway, Ealing.*
121	1889. Jan.	‡Potter, Thomas Wickford, *Estate Works, Thoresby Park, Ollerton, Notts.*
154	1889. Feb.	Powell, David Henry William, *Surveyor, Pontypool.*
123	1889. Jan.	‡Pratt, Joseph, 12, *Kirkdale, Sydenham.*
161	1889. Mar.	‡Press, William James, *Rose Villa, Abingdon Street, Burnham, Somerset.*
615	1892. Oct.	Pringle, Andrew, *Cromwell House, Bexley Heath, Kent.*

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68 1888. Oct. Proger, John L., 11, *Cwrtiy-vie Road*, *Penarth*, *Cardiff*.
69 1888. Oct. ‡Rains, Joseph, *Kettering*.
517 1892. Feb. ‡Reavell, Frank Noble, *Maybank Road*, *South Woodford*.
70 1888. Oct. ‡Reavell, George, Jun., *Alnwick*, *Northumberland*.
71 1888. Oct. ‡Richards, Daniel, *Elwyn Villa*, *South Molton*.
606 1892. June. ‡Richards, William, 18, *Nunhead Grove*, *Peckham Rye*, *S.E.*
506 1892. Feb. ‡Roberts, David Morris, *Berlin House*, *High Street*, *Portmadoc*.
263 1890. Apr. ‡Robertson, John Shirras, *Princes Street*, *Thurso*.
618 1892. July. ‡Robins, H. G., 29, *West End Lane*, *London*, *N.W.*
228 1890. Jan. ‡Robinson, John, 79, *Lavender Road*, *Clapham Junction*.
507 1892. Feb. ‡Robson, Lancelot, 12, *Stockton Street*, *West Hartlepool*.
633 1892. Sept. ‡Rodwell, Ascough, *Union Offices*, *Skipton*, *Yorkshire*.
410 1891. July. ‡Roe, Edward Charles, Junr., *Rosenaw*, *Maswell Park*, *Hounslow*, *Middlesex*.
72 1888. Oct. ‡Rogers, Richard, *Maes Helew*, *Carnarvon*.
589 1892. May. ‡Roper, Joseph Stanley, *Surveyor and Inspector to Rural Sanitary Authority*, *Greenway Court*, *Hollingbourne*, *Maidstone*.
422 1891. June. ‡Rossiter, Robert Herbert, 15, *Sloane Terrace*, *Sloane Street*, *Chelsea*, *S.W.*
648 1892. Oct. ‡Rothera, Frederick, 71, *Beech Road*, *Sowerby Bridge*, *Yorkshire*.
620 1892. July. ‡Row, Edmund, 10, *Granville Road*, *Hoe Street*, *Walthamstow*, *Essex*.
449 1891. Nov. Rowe, Wm. Thomas Ferdinand, *Sanitary Engineer*, 41, *Old Town Street*, *Plymouth*.
463 1891. Nov. ‡Rowland, Arthur, 5, *Cambridge Street*, *Hull*.
565 1892. May. ‡Royle, Charles, 51, *Wormgate*, *Boston*, *Lincoln*.
605 1892. June. ‡Rowland, Samuel, *Pontypridd*.
283 1890. May. ‡Ruscoe, Ernest Henry, 6, *Great Castle Street*, *Regent Street*, *W.*
205 1889. July. ‡Ryder, Albert Thomas, *Dudley Villa*, *Foster Hill Road*, *Bedford*.
125 1889. Jan. ‡Sadleir, Richard J., "*Woodcote*," *Ormeley Road*, *Balham*.
73 1888. Oct. ‡Salter, Thomas, 2, *King's Rd.*, *St. Leonards-on-Sea*.
580 1892. May. ‡Sandon, Edward H., 327, *Harrow Road*, *W.*
293 1890. May. ‡Saunders, Percy, 46, *Jarvis Road*, *South Croydon*.
303 1890. June. ‡Savory, Charles, 6, *Holford Place*, *W.C.*
367 1891. Feb. ‡Scott, Margaret Eleanor, 133, *Abbey Road*, *South Hampstead*, *N.W.*
74 1888. Oct. Sedgwick, Sydney, 10, *Mortimer Street*, *Cavendish Square*, *W.*

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460 1891. Nov. ‡Senior, John Sidney, 3, *Queen's Road, Gosport.*

76 1888. Oct. ‡Shadrake, W. A., 8, *Hind Street, Stainsby Road, Poplar, E.*

555 1892. Apr. ‡Shapley, William Gilbert, 37, *Copeland Road, Peckham.*

660 1892. Nov. Sharpe, William Charles, *Morecambe Villa, Great Grimsby, Lincoln.*

210 1890. Feb. ‡Shaw, Peter, 98, *Church Street, Fulham Road, S.W.*

126 1889. Jan. ‡Sheldon, W. E., *The Croft, Wantage, Berks.*

513 1892. Feb. ‡Shill, Albert Edmund, 30, *Dayton Grove, Peckham.*

77 1888. Oct. ‡Shore, Ambrose J., 68, *Adys Road, East Dulwich.*

172 1889. Apr. ‡Short, James Allen, *Sanitary Department, Wigan.*

470 1891. Nov. ‡Shufflebotham, William, *Roche House, Weston Street, Leek.*

551 1892. Apr. ‡Shuttleworth, William, *Town Hall, Salford, Lancashire.*

537 1892. Mar. ‡Siddall, Joseph, *Ashton-under-Lyne.*

173 1889. Apr. ‡Sidwell, Henry Thomas, *Elm Cottage, Herne Bay, Kent.*

428 1891. July. ‡Simmons, Edward John, 80, *Paulet Rd., Camberwell.*

78 1888. Oct. ‡Simmons, Nimrod, *Glendale, Clifton, Bristol.*

542 1892. Mar. ‡Simmons, Thomas, 50, *Victor Road, Seven Sisters Road, N.*

271 1890. May. ‡Simpson, John, 30, *Belmont Street, Aberdeen.*

221 1890. Jan. ‡Simpson, John Thomas, 28, *King's Road, Peckham.*

527 1892. Feb. ‡Simpson, R. D. J., *Knott Street, Deptford.*

456 1891. Nov. Sinclair, Prof. William A., M.D., A.M., *Howard University, Washington D.C., U.S.A.*

512 1892. Feb. ‡Slater, Herbert, 24, *Bond Street, Leeds.*

356 1891. Feb. ‡Small, Walter Herbert, *Station Road, St. Dunstans, Canterbury.*

651 1892. Oct. ‡Smith, Fred. William, 92, *St. Leonard Gate, Lancaster.*

502 1892. Feb. ‡Smith, George, 15, *St. Ann's Terrace, St. John's Wood.*

79 1888. Oct. ‡Smith, George Allen, *Vestry Hall, Hampstead.*

552 1892. Apr. ‡Smith, Joseph Charles, *Sanitary Committee, County Borough of Leeds, Yorkshire.*

306 1890. June. ‡Smith, Joseph Sidney, 73, *Elm Park, Brixton Hill, S.W.*

587 1892. May. ‡Smith, Percy A., 474, *New Cross Road, S.E.*

597 1892. June. ‡Smith, Richard, Jun., *Salterns Rd., Parkstone, Dorset.*

338 1890. Nov. Smith, Sydney, *Dorset Cottage, Hastings Rd., Bexhill.*

416 1891. June. ‡Smith, Warren B., 66, *College Street, Chelsea.*

298 1890. June. ‡Smith, W. H., 60, *Alma Vale Road, Clifton, Bristol.*

631 1892. Sept. ‡Smithies, Arthur, *Albert Avenue, Starbeck, Harrogate.*

80 1888. Oct. ‡Soper, Henry Charles, 108, *Park Street, Camden Town, N.W.*

95 1888. Oct. ‡Sortwell, W., 14, *Retreat Place, Paragon Road, Hackney, E.*

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81 1888. Oct. SOUTHPORT, The Mayor and Corporation of.

632 1892. Sept. ‡SPEIGHT, Harry, *Kirkhamgate, Wakefield, York.*

352 1891. Feb. ‡SPENCER, Julius, 6, *Lord Street, Keighley.*

593 1892. June. ‡SPINK, Joseph, *Dale House, Formby, Liverpool.*

82 1888. Oct. ‡STANLEY, A. W., *Newington, Hull.*

553 1892. Apr. ‡STANLEY, Walter, 29, *Somerville Terrace, Sheffield, Yorkshire.*

511 1892. Feb. ‡STANNARD, Harry William, *Market Place, Rugby.*

540 1892. Mar. ‡STANSFIELD, Alfred, 2, *Tokenhouse Buildings, E.C.*

83 1888. Oct. ‡STEERS, George, 21, *Brereton Road, Bedford.*

84 1888. Oct. ‡STEVENSON, John, *Surveyor's Office, East Molesey, Surrey.*

583 1892. May. ‡STEWART, James, 28, *Crozier Street, Westminster Bridge Road, S.E.*

652 1892. Oct. ‡STEWART, Robert Tomlinson, *Thorpe-le-Soken, Essex.*

369 1891. Feb. ‡STOLLERY, William, *Dust Depôt, Culvert Road, Battersea.*

526 1892. Feb. ‡STREATHER, William Turner, 4, *Lismore Road, Gospel Oak, N.W.*

174 1889. Apr. ‡STRUTT, Thomas Frederick, 5, *Tavistock Street, Covent Garden, W.C.*

662 1892. Nov. ‡SURTEES, Richard Thos., 29, *Old Gate Street, Morpeth, Northumberland.*

487 1892. Jan. ‡SUTCLIFFE, Alfred, *Thornton, Bradford.*

238 1890. Feb. ‡SUTHERLAND, Walter, 8, *Voelas Street, Liverpool.*

324 1890. Nov. ‡SUTTLE, Alfred, *Manor Square, Otley.*

481 1891. Dec. ‡SWITZER, Sidney A., 9, *Derby Street, Gray's Inn Road, W.C.*

325 1890. Nov. ‡SYDENHAM, Sydney, 37, *Broad Street, Bath.*

140 1889. Jan. ‡TAIT, James, *Roslyn Place, Dean Street, Kilmarnock.*

127 1889. Jan. ‡TATE, William, 29, *Kenilworth Road, Kilburn.*

405 1891. June. ‡TAYLOR, Albert, *Vestry Hall, Mount Street, W.*

659 1892. Nov. ‡TAYLOR, Harry James, *County Local Surveyor, Sturminster Newton, Dorset.*

472 1891. Nov. ‡TAYLOR, Harry William, *Town Surveyor's Office, Newmarket.*

321 1890. Nov. ‡TAYLOR, Henry Thomas, 10, *Higham Street, Everton, Liverpool.*

128 1889. Jan. ‡TAYLOR, James, 17, *Oxford Street, Hereford.*

278 1890. May. ‡TAYLOR, James, 10, *Mount Pleasant, Waterloo, Liverpool.*

129 1889. Jan. ‡TEMPLE, William Herbert, *Scarborough.*

539 1892. Mar. ‡THATCHER, Albert George Hendy, *Hampton Court Palace, W.*

279 1890. May. ‡THOMAS, George, 356, *Iverdale Road, Nunhead, S.E., and City of London Electric Lighting and Engineering Office, Portland House, Basinghall Street, E.C.*

86 1888. Oct. ‡THOMAS, Thomas, 4, *Chandos Road, Redlands, Bristol.*

Reg. No. Date of Election.

370 1891. Feb. ‡Thomas, Thomas F., 32, *West Square, St. George's Road, Lambeth.*

85 1888. Oct. ‡Thomas, W. K., 42, 43 & 44, *Triangle, Clifton, Bristol.*

316 1890. Oct. Thompson, Bernard H., *Royal Engineers' Office, Windsor.*

434 1891. July. ‡Thompson, Ralph, 29, *Hall Hill Bank, Hexham.*

156 1889. Feb. ‡Thorpe, James, 19, *King Edward Street, Macclesfield.*

557 1892. Apr. ‡Tindell, Robert L., 47, *Burley Lodge Terrace, Leeds.*

517 1892. Mar. ‡Titmuss, Joseph E., 59, *Commerce Road, Wood Green, N.*

296 1890. June. ‡Tomkins, Alfred, 62, *Church Street, Camberwell.*

452 1891. Nov. ‡Tomkys, F. L., *Yeovil, Somerset.*

543 1892. Mar. ‡Tomlinson, Frank, 59, *Sheriff Street, Rochdale.*

558 1892. Apr. ‡Toms, William Charles, 14, *Evandale Road, Brixton.*

536 1892. Mar. Travis, David, *Chief Sanitary Inspector, Halifax.*

550 1892. Mar. Trevena, George, *Overton, Marlborough.*

322 1890. Nov. ‡Trigg, Henry John, *Martock, Somerset.*

436 1891. July. ‡Trowsdale, Tom James, 12, *Leybourne Terrace, Stockton-on-Tees.*

87 1888. Oct. Tuckey, George F., 47, *Milk Street, Bristol.*

305 1890. June. ‡Turner, Alfred, 49, *Ellora Road, Streatham, S.E.*

378 1891. Mar. ‡Twaits, James, 21, *Latham Street, Poplar, E.*

343 1890. Dec. Veasey, Thomas Frederick, ASSOC.M.INST.C.E., *care of O. H. Veasey, Bridge House, Huntingdon.*

421 1891. June. ‡Vincent, George Edwards Bussell, 55, *Mayfield Road, Dalston.*

388 1891. Mar. ‡Waddington, Thos. W., 8, *Albert Street, Padiham.*

310 1890. June. ‡Walker, Francis, 23, *Woodstock Road, Shepherd's Bush, W.*

626 1892. Sept. ‡Wall, Samuel Edward, A.R.I.B.A., 26, *Mount View Road, Stroud Green, London.*

88 1888. Oct. Wallace, Miss J., 6, *Hyde Park Gardens.*

215 1889. Nov. Wallas, Irwin Clarke, 41, *Cavendish Road, Clapham Common, S.W.*

319 1890. Nov. Wallis, Thomas Wilkinson, *Surveyor, Louth. Lincoln.*

273 1890. May. ‡Wansbrough, Cecil Shartman, *Arlington Villa, Barrow-in-Furness.*

564 1892. May. ‡Warran, William Ernest, 5, *Broad Park Villas, Whitchurch Road, Tavistock.*

489 1892. Jan. ‡Watson, Harry John James, 5, *Upper John Street, W.*

531 1892. Mar. ‡Watson, Thomas, *Kirkoswald, Cumberland.*

492 1892. Jan. Watson, William Hill, *Vestry Hall, Piccadilly.*

98 1888. Nov. Watts, George Nelson, 147, *High Street, Notting Hill, W.*

232 1890. Jan. ‡Watts, Gerald, *Local Board of Health, St. George's, Bristol.*

216 1890. Feb. ‡Watts, William Frederick, *Bitterne, Southampton.*

571 1892. May. ‡Weatheritt, James, *Town Hall, Newcastle-upon-Tyne.*

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89	1888. Oct.	‡Webb, James A., *Town Hall, Fulham.*
318	1890. Nov.	‡Weeks, Alfred James, *Toularabia Road, Clapham Common, S.W.*
90	1888. Oct.	‡Wells, G. F., 37, *Prospect Street, Hull.*
576	1892. May.	‡Wells, William James, *Lower Kingswood, Reigate.*
595	1892. June.	‡White, William, 27, *Harvey Street, Folkestone.*
371	1891. Feb.	‡White, William Owen, 8, *Albert Street, Banbury.*
554	1892. Apr.	‡Whitehead, James, 38, *Raumarsh Hill, Park Gate, Rotherham.*
508	1892. Feb.	‡Whitham, Joseph, *Shelf, Halifax.*
413	1891. June.	‡Whittome, Philip Alfred, *The Chestnuts, Rothesay Road, Bedford.*
541	1892. Mar.	‡Wilkinson, George H., 83, *Townsend Lane, Anfield, Liverpool.*
91	1888. Oct.	‡Wilkinson, W., *Ford Street, Derby.*
574	1892. May.	Wilkinson, William, *Sanitary Inspector, Altofts.*
320	1890. Nov.	‡Willbond, George Baines, *Guildhall, Nottingham.*
642	1892. Oct.	‡Williams, George, 6, *Priory Road, Everton, Liverpool.*
498	1892. Feb.	‡Williams, Joseph, 30, *Goldhurst Terrace, Finchley Road, N.W.*
387	1891. Mar.	Williams, Llewellyn A., 80, *Easton Street, High Wycombe.*
545	1892. Mar.	‡Williams, Richard Jun., 14, *Lucerne Street, Lark Lane, Sefton Park, Liverpool.*
162	1889. Mar.	‡Wilson, Charles Turle, 37, *Burney Street, Greenwich, S.E.*
198	1889. June.	‡Wilson, John, *Town Hall, Kensington.*
206	1889. July.	‡Wilson, William, *Grasington Terrace, South Shields.*
372	1891. Feb.	‡Windle, Thomas, 8, *Tennis Street, Burnley.*
641	1892. Oct.	‡Windsor, William, 13, *Sutcliffe Street, Liverpool, E.*
92	1888. Oct.	‡Winser, F. Sawyer, 52, *Buckingham Palace Road, S.W.*
602	1892. June.	‡Winsborrow, Edwin James, *Town Hall, Westminster.*
175	1889. Apr.	‡Winter, Edward, 19, *King's Gardens, W. Brighton.*
657	1892. Nov.	‡Wood, Alfred, *Bury, Lancashire.*
441	1891. July.	‡Wood, Charles Bruce, 37, *Irene Road, Parsons Green, S.W.*
600	1892. June.	‡Wood, Charles Fred, 1, *Cedar Villas, W. Hampstead.*
131	1889. Jan.	‡Wood, Peter, 177, *Ashmore Road, Paddington.*
209	1889. July.	Woodcock, Henry, 16, *Steelhouse Lane, Birmingham.*
451	1891. Nov.	‡Woodeson, William, 1a, *Charles Street, Pendleton, Manchester.*
379	1891. Mar.	‡Woodhouse, Tom, 25, *Worsley Road, Leytonstone, E.*
514	1892. Feb.	‡Woodman, Henry Frederick, 18, *Burlington Road Westbourne Park.*
163	1889. Mar.	‡Woonton, James, 64, *Anthony Street, E.*

Reg. No.	Date of Election.	
431	1891. July.	‡WORRALL, Ernest, 5, *Beaconsfield Terrace, Seacombe, Liverpool.*
473	1891. Nov.	‡WORRALL, William Henry, 208, *High Street, Harborne.*
276	1890. May.	‡WRACK, Thomas Philip, 15, *Great Alie Street, Whitechapel.*
132	1889. Jan.	‡WRIGHT, John, Junr., 3, *Surbiton Park Terrace, Kingston-on-Thames.*
504	1892. Feb.	‡YATES, Robert, 42, *Lupus Street, St. George's Sq., S.W.*
491	1892. Jan.	‡YOUNG, Frank Russell, 60, *Elmsdale Road, Walthamstow, Essex.*
532	1892. Mar.	‡YOUNG, Isaac, 39, *Dorothy Road, Lavender Hill.*

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COURTNEY, MAJOR D. C., R.E.
COWTAN, Frank.
CRANBROOK, THE RT. HON. VISCOUNT, G.C.S.I.
CRIMP, W. Santo, M.INST.C.E., F.G.S.
DARCH, John.
DAWSON, Charles James.
DE CHAMONT, Miss A. K. F.
DENDY, William Cooper.
DENTON, Eardley Bailey, B.A., M.INST.C.E.
DICKINSON, William Gilbert, L.R.C.P., M.R.C.S., D.P.H.
DODD, Peter, ASSOC.M.INST.C.E.
DOULTON, James Duncan.
DRAYSON, Walter B. H.
ECCLES, Miss Jane Helen.

London—*Continued.*

Emerson, W. f.r.i.b.a.
Erichsen, J. Eric., f.r.s.
Evers, Surg. Major B.
Farrer, Sir T. H. Bart.
Felkin, Howard Riley.
Field, Horace.
Fisher, T. J.
Forde, H. C., m.inst.c.e.
Fraser, W. J., assoc.m.inst.c.e.
Galton, Francis, f.r.s.
Gay, John, m.r.c.s., l.r.c.p., d.p.h.
Gladstone, J. H., ph.d., f.r.l.
Glaister, John, m.d., d.p.h.
Glen, A. W.
Grantham, Richard Fuge, m.inst.c.e.
Gray, Alexander.
Grellier, William, f.r.i.b.a.
Hall, E. T., f.r.i.b.a.
Hancock, Charles, m.a.oxon.
Hare, C. J., m.d., f.r.c.p.
Harrison, William Joseph, assoc.m.inst.c.e., f.r.met.soc.
Haslip, George Ernest, m.d., m.r.c.s., l.r.c.p., d.p.h.
Hayward, C. F., f.s.a., f.r.i.b.a.
Hellyer, S. Stevens.
Hill, Miss F. M. Davenport.
Hill, Pearson.
Hill, Miss R. Davenport.
Hill, Samuel, a.r.i.b.a.
Hill, William H.
Hills, Harry James.
Hodgetts, E. A. Brayley.
Hodgson, Shadworth H.
Holmes, Timothy, m.a., f.r.c.s.
Howard, E.
Howe, George.
Hoy, Peter.
Inglis, Cornelius, m.d.
James, Charles Alfred, l.r.c.p., m.r.c.s., d.p.h.
Kempster, William Henry, m.d., m.o.h.
Kennett-Barrington, Sir Vincent Hunter, V.
Kenwood, Henry R., m.b., l.r.c.p., d.p.h., f.c.s.
Lacy, William George.
Lavender, Charles Henry Nalder.
Lawford, George Maxwell, assoc.m.inst c.e., m.soc.e.
Law, Herbert Henry, assoc.m.inst.c.e.
Lawrence, Edwin.
Le Grand, A.
Lemon, James, m.inst.c.e., f.r.i.b.a., f.s.i., f.g.s.
Leonard, Hugh.
Le Rossignal, Francis, f.s.i.
Letts, Thomas Hollins.
Little, John Fletcher, m.b., m.r.c.p., m.o.h.
Lloyd, Robert Samuel.
Loane, Joseph, m.r.c.p.e., d.p.h., m.o.h.
Lynde, Fredk. Charles, assoc.m.inst.c.e.
Lyon, Washington.
Macassey, L. Livingston, m.inst.c.e.
Mackenzie, F. Morell, m.r.c.s., l.s.a.
Mackey, John B.
Martindale, William.
Martineau, E. H., f.r.i.b.a.
Mason, Hugh H., m.r.c.s.
Mathews, J. Douglass, f.r.i.b.a., f.s.i.
McArthur, A., m.p.
McKie, Hugh Umsworth, m.inst.c.e.
McMorran, Alexander.
Mineard, George Edward, f.r.h.s.
Mocatta, F. D.
Montagu, Samuel.
Moore, Albert, f.i.c.
More, James, Jun., assoc.m.inst.c,e., f.r.m.s.
Morley, J. G., assoc.m.inst.c.e.
Mouat, F. J., m.d.
Mouat, Surgeon-Gen. J., c.b., f.r.c.s.
Munday, Major Henry.
Murphy, Francis Henry Swinton, m.d., d.p.h.
Nanson, Tom.
Nash, Brigade-Surgeon William, m.d.
Nelson, E. M.
Newton, Edward, f.r.c.s.
Pagliardini, T.
Parkes, Miss P.
Parsons, H. Franklin, m.d.
Patten, Charles Arthur, l.r.c.p., m.o.h.
Pasteur, William.
Pilley, John J.
Poulson, Frederick Thomas.
Powell, George Thompson.
Priestly, Mrs. Eliza.
Pritchett, G. E., f.s.a., f.r.i.b.a.
Purnell, E. W.
Purnell, W. J.
Quain, Sir R., m.d., f.r.s.
Radford, John Chas., assoc.m.inst.c.e.
Railton, James.
Reynolds, Mrs. Russell.
Rhodes, John William.
Ridings, H. Sadleir, m.a., m.inst.c.e.
Roberts, Frederick F., m.d.
Robins, Edward.
Roe, Surgeon-Major, E. A. H.
Rogers, George Arthur, m.r.c.s.e., l.s.a., m.o.h.
Scott, Bowes.
Scott-Moncrieff, W.D., m.i.m.e.
Scriven, J. Barclay, m.r.c.s.
Searles-Wood, Herbert D., f.r.i.b.a.
Shaw, Charles Knox, l.r.c.p., m.r.c.s.
Shone, Isaac, assoc.m.inst.c.e.
Sillar, W. C.
Smith, Percival Gordon, f.r.i.b.a.
Smith, T. V.
Smith, Urban Armstrong, assoc.m.inst. c.e.

LONDON—*Continued.*

SNELL, Alfred W., A.R.I.B.A.
SOUTHAM, Arthur, ASSOC.M.INST.C.E.
STEPHENSON, J. Gurdon L., ASSOC.M. INST.C.E., M.I.M.E., F.G.S.
STEVENSON, Thomas, M.D.
STIFF, Ebenezer.
STREET, William C., A.R.I.B.A., ASSOC.M. [INST.C.E.
SUDELEY, RT. HON. LORD.
SWAN, Harold.
SWINBURNE, C. A.
TAYLOR, Charles, M.R.C.S., L.S.A.
THOMPSON, Geo. Wm., ASSOC.M.INST.C.E.
THOMPSON, Thos. Wm., L.R.C.P., M.R.C.S., D.P.H., M.O.H.
THRING, RT. HON. LORD, K.C.B., F.R.G.S.
TITMAS, William.
TRAVERS, William, M.D, F.R.C.S.
TYNDALE, Walter Clifford, ASSOC.M.INST. [C.E.
VALON, William A., ASSOC.M.INST.C.E.
VERDON, H. Walter, M.D., F.R.C.S., M.O.H.
WALLACE, William.
WALLIS, H. Sowerby, F.R.MET.SOC.
WALLIS, Isabel White.
WALTON, Rienzi G., M.INST.C.E.
WELLS, SIR T. Spencer, BART., M.D., F.R.C.S.
WHEELER, Charles.
WHITAKER, William, B.A., F.R.S., F.G.S.
WHITCOMBE, Arthur.
WHITE, William, F.S.A., F.R.I.B.A.
WIGHTWICK, Fallon Percy, M.B., M.R.C.S., L.R.C.P., D.P.H.
WILLIAMS, C. Theodore, M.A., M.D., F.R.C.P., F.R.MET.SOC.
WINDLE, Jabez Davenport, M.R.C.S., L.R.C.P., M.O.H.
WOOD, Jacob.
WOOD, William, M.D.
WORTH, John Edward, ASSOC.M.INST.C.E., F.R.MET.SOC.
WYNDHAM, REV. Francis M., M.A.OXON.
YUILL, W., ASSOC.M.INST.C.E.

Associates:—

ADAMS, Albert E.
ADAMS, H. J.
ADAMS, Miss Rose.
ANDERSON, Tom.
ANDREWS, Daniel James.
ANNETT, William Fenn.
ANTHONY, Frederick Joseph.
ASHDOWN, Thomas.
ATHEY, Frederick.
ATKINS, Robert William.
BARFOOT, James.
BARTLETT, William John.
BARRON, John.
BASSETT, William Joshua.
BAXTER, Frank E.
BAXTER, John.
BIRCH, John Ernest William.
BLAKE, E. T., M.D.
BLAKE, H. K.
BOND, William Henry.
BOVEY, William T.
BOYCE, W.
BOYD, Richard Wade.
BROAD, Clement B.
BROWN, Robert, Jun.
BROWN, Robert Frederick.
BRYAN, George John.
BUCKERIDGE, Walter.
BUGLER, W. J.
BURN, Robert G. N.
BURROUGHS, S. M.
BURTON, W. H.
BUTCHER, Charles Ernest.
BUTLAND, R. J.
CARTER, Alfred.
CARY, Aquilla S.
CATTEN, Joseph H.
CAVE, James.
CHANEY, William H.
CHAPPELL, William.
CLARKE, Robert Edwyn.
CLIFTON, Henry Charles.
COCKBURN, Henry Mace.
COLLINS, Henry Beale.
COOK, Alfred.
COOK, William George.
COOK, William Gough.
CORBY, Thomas.
CORP, James.
COURT, Thomas Henry.
COWPER, Joseph.
COXILL, George E.
CRABBE, W. G.
CROCKER, Thomas William.
CRONK, William Robert.
CROSSE, Hammond William.
DALE, Duncan.
DAVIES, T. Lane.
DEE, Thomas George.
DENSHAM, Charles A.
DOCKING, Frederick Reynolds.
DOVER, John Henry.
DUCK, Albert George.
DYKE, Alfred William.
EARWICKER, John Charles.
EDMONDS, William H.
EDWARDS, John.
EVANS, John Evan.
FAIRCHILD, Samuel C. G.
FAIREY, Alfred Isaac.
FISHER, Robert.
FOAD, Cephas.
FOLLAND, John Percy.
FORDHAM, William Francis.
FOSTER, Edward.
GARNHAM, Albert Edward.
GATHERCOLE, William Henry Joseph.

London—*Continued.*

Gilbeart, John Joseph.
Goodman, Herbert.
Gorniot, Thomas Arthur.
Gough, Joseph.
Grant, Alexander.
Green, William.
Grigg, William Henry.
Groom, William Edwin.
Hall, George Berringer, F.G.S.
Hartnoll, Francis.
Hallon, Charles
Head, Robert H.
Hearn, Walter.
Helsdon, Horace.
Henley, Amos S.
High, George Frederick.
Hills, Arthur Reginald.
Hooper, William.
Horncastle, Henry.
Horton, Richard.
Horton, William.
Houghton, Robert Alfred.
Iles, Alfred Robert.
Johnson, H. Watts.
Johnson, John William.
Jones, Charles Bristow.
Jones, John.
Jones, Julius Morris Wilson.
Jury, H. A.
Kelf, Charles Harvey.
Kemsley, Jesse.
Kennedy, Daniel.
Kershaw, Edward Baxter.
Kilgallin, Charles J.
King, Albert S. W.
Kite, Charles.
Knight, William Henry.
Knox, Charles Geary.
Lamport, Miss Ethel Frances.
Lander, James.
Lapworth, J.
Laurie, John.
Lear, James Walter.
Legg, S. C.
Lightfoot, Thomas.
Lightfoot, William Charles.
Lilly, William Gent.
Loasby, Frederick W.
Lund, Jeremiah.
MacIntosh, James.
Mackay, James John.
Martin, Alexander William.
May, William H.
McDonald, A. L.
Middleton, H.
Miller, Frederick William.
Mills, Walter Shephard.
Milner, Walter.
Miners, Richard Eustace.
Mitchell, Charles Frederick.
Mitchell, Edward.
Mitchener, Frederick Harry.
Nettleton, Charles William.
Newnham, Frank George.
Newson, George John.
Nicholas, David.
Norman, Ernest William.
Nurcombe, Benjamin.
Nutley, Charles Vernon.
Ord, James.
Parham, John, Jun.
Parkinson, Herbert William.
Parsons, William.
Perry, Arthur.
Pettit, George Mackness.
Phillips, Henry.
Poole, James.
Pilbeam, Francis Newcastle.
Pratt, Joseph.
Richards, William.
Robins, H. G.
Robinson, John.
Rossiter, Robert Herbert.
Ruscoe, Ernest Henry.
Sadlier, Richard J.
Sandon, Edward H.
Saunders, Percy.
Savory, Charles.
Scott, Margaret Eleanor.
Sedgwick, Sydney.
Shadrake, W. A.
Shapley, William Gilbert.
Shaw, Peter.
Shill, Albert Edmund.
Shore, Ambrose J.
Simmons, Edward John.
Simmons, Thomas.
Simpson, John Thomas.
Smith, George.
Smith, George Allen.
Smith, Joseph Sidney.
Smith, Percy A.
Smith, Warren B.
Soper, Henry Charles.
Sortwell, W.
Stansfield, Alfred.
Stewart, James.
Stollery, William.
Streather, William Turner.
Strutt, Thomas Frederick.
Switzer, Sidney A.
Tate, William.
Taylor, Albert.
Thatcher, Albert George Hendy.
Thomas, George.
Thomas, Thomas F.
Titmuss, Joseph E.
Tomkins, Alfred.
Toms, William Charles.
Turner, Alfred.
Twaits, James.
Vincent, George Edwards Russell.
Walker, Francis.

LONDON—*Continued.*

WALLACE, Miss J.
WALLAS, Irwin Clarke.
WATSON, Harry John James.
WATSON, William Hill.
WATTS, George Nelson.
WEBB, James A.
WEEKS, Alfred James.
WILLIAMS, Joseph.
WILSON, Charles Turle.
WILSON, John.
WINDSOR, William.
WINSER, F. Sawyer.
WINSBORROW, Edwin James.
WOOD, Charles Bruce.
WOOD, Charles Fred.
WOOD, Peter.
WOODHOUSE, Tom.
WOODMAN, Henry Frederick.
WOONTON, James.
WRACK, Thomas Philip.
YATES, Robert.
YOUNG, Isaac.

MIDDLESEX.

Fellow:—

TWINING, Thomas.

Members:—

GRUGGEN, William, D.P.H.
JONES, Charles, M.INST.C.E.
LAFFAN, G. B., ASSOC.M.INST.C.E.

Associates:—

BROWN, Reginald.
JACOB, Oswald.
MASON, Frederick William.
MUNRO, Andrew John
POTTER, Benjamin.
ROE, Edward Charles, Junr.
WALL, Samuel Edward, A.R.I.B.A.

NORFOLK.

Fellows:—

COLMAN, J. J., M.P.
OLLARD, William Ludlam.
OLLARD, J. F.

Member:—

BURTON, Samuel Hubert, F.R.C.S., M.O.H.

Associates:—

ALLEN, Thomas Holtan.
CANNELL, Charles Stephen.
CRANE, Joseph.
MILLER, Henry.
PANK, Richard Henry.

NORTHAMPTON.

Members:—

BROWN, William Ibbs.
BURGESS, Saml. Edwin, ASSOC.M.INST.C.E.

Associates:—

HARPER, Frank.
LEWIS, Arthur.
MOSLEY, Abraham.
RAINS, Joseph.

NORTHUMBERLAND.

Members:—

ARMSTRONG, Henry E., M.R.C.S., L.S.A., M.O.H.
LAING, R., M.R.C.S., L.R.C.P., F.R.MET.SOC., M.O.H.
WILKINSON, W. B.

Associates:—

CRUDEN, John.
KIRK, William Hugh.
MEADOWS, John William.
REAVELL, George, Jun.
SURTEES, Richard Thomas.
THOMPSON, Ralph.
WEATHERITT, James.

NOTTINGHAM.

Members:—

BOOBBYER, Philip, M.B., M.R.C.S., M.O.H.
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COOPER, Francis A., ASSOC.M.INST.C.E.
PARKER, John, ASSOC.M.INST.C.E.
RADFORD, W. H., ASSOC.M.INST.C.E., A.R.I.B.A.

Associates:—

CLAYTON, Edward.
GRIFFIN, George Frederick Augustus.
HOLMES, John Edward.
POTTER, Thomas Wickford.
WILLBOND, George Baines.

OXFORDSHIRE.

Fellow:—

ACLAND, SIR Henry W., K.C.B., M.D., D.C.L., F.R.S.

Associates:—

JACKSON, Henry James.
WHITE, William Owen.

RUTLANDSHIRE.

Member:—

BELL, Thomas, L.R.C.P.LOND.

SCOTLAND.

Fellows :—

RUSSELL, James A., M.A., F.R.C.P.EDIN., M.B., B.S.C., F.R.S.E.
RUSSELL, J B., M.D., LL.D., M.O.H.

Members :—

ANDERSON, John, ASSOC.M.INST.C.E.
BLACK, SURGEON-MAJOR W. G.
BRUCE, William, M.D., LL.D., M.O.H.
CONNAL, Ebenezer, M.INST.C.E.
FRAZER, James, M.INST.C.E.
GRANT, Ogilvie, M.B., C.M.EDIN., M.O.H.
MACKENZIE, William Leslie, M.A., M.B., C.M., D.P.H., COUNTY M.O.H.
MCNEILL, Roger, M.D., D.P.H., J.P.
MITCHELL, Lewis.
NASMYTH, Thomas Goodall, M.B., C.M., D.P.H., F.R.S.E.
NICOL, W. E.
PULLAR, Robert, J.P., F.R.S.E.
SMITH, John, ASSOC.M.INST.C.E.
THOMPSON, Gilbert.
WALLIS, Arthur Gray.
WATSON, John Duncan, ASSOC.M.INST.C.E.
WILLIAMS, William Iltyd.
WILLIS, George, L.F.P.S.G., M.O.H.

Associates :—

BLACK, Andrew E.
BUCHAN, W. Paton.
CURRIE, Thomas.
DICK, William.
DUTHIE, Alexander.
GAIRDNER, Prof. W. T., M.D., LL.D.
GILLIES, Neill.
GUNN, Alexander.
HAY, Alexander.
KNIGHT, Robert, Jun.
MACKAY, George Archibald D.
MACLENNAN, John.
MARTIN, William, Jun.
MILNE, George.
MORRIS, G. John.
ROBERTSON, John Shirras.
SIMPSON, John.
TAIT, James.

SHROPSHIRE.

Members :—

CORKE, Cecil A., L.R.C.P., M.O.H.
DAVIS, Alfred T., ASSOC.M.INST.C.E.
HUNTER, Alexander H.
THURSFIELD, W. N., M.D., D.P.H., M.O.H.

Associates :—

BREEZE, John.
CORBETT, Richard Lawrence.
DALTRY, John.
MOLINEUX, Walter Frank Yate.

SOMERSET.

Members :—

AMES, H. St. Vincent, M.A.
BERNARD, William Larkins.
CLOTHIER, Samuel Thompson.
COATES, C., F.R.C.P.
FLOWER, Thos. James Moss, F.R.MET.SOC.
GILBY, Charles.
GILL, D.
SAISE, Alfred James.
SKRINE, Henry Duncan.
TREW, J. Fletcher.
WOODWARD, Edward Francis.

Associates :—

AMOR, Alfred.
BIRD, William Fred.
BISHOP, William F.
BUBB, John Thomas.
COLES, John Thomas.
GREENWELL, Allan.
LISCOMBE, Charles F.
MAXWELL, William Henry.
PERRY, Walter Harold.
PRESS, William James.
SIMMONS, Nimrod.
SMITH, W. H.
SYDENHAM, Sydney.
THOMAS, Thomas.
THOMAS, W. K.
TOMKYS, F. L.
TRIGG, Henry John.
TUCKEY, George F.
WATTS, Gerald.

STAFFORDSHIRE.

Fellow :—

REID, George, M.D., D.P.H.

Members :—

BERRINGTON, R. E. W., ASSOC.M.INST.C.E.
BLUMER, Frederick Milnes, B.A., M.B., M.O.H.
BOSTOCK, H.
JOHNSON, Samuel, M.D., C.M., M.O.H.
THORNEYCROFT, LIEUT.-COL.
UNDERHILL, A. S., M.B., B.A., M.R.C.S., D.P.H.
WAKEFIELD, Miss E. M.

Associates :—

BEECH, James.
CHESHIRE, Alfred.
COLLYER, J.
HODGES, Albert.
HUGHES, Walter.
INSKIP, Frederick Thomas.
LOWERY, James.
LOWERY, Thomas Augustus.
MADIN, William B.
SHUFFLEBOTHAM, William.
WORRAL, William Henry.

SUFFOLK.

Members:—

KAY, Walter Robert.
MORRIS, Pryce Jones Langford, M.R.C.S., L.R.C.P., M.O.H.

Associate:—

JASPER, Robert Wevill.

SURREY.

Fellows:—

ALBANY, H.R.H. THE DUCHESS OF.
JONES, LIEUT-COL. A. S., V.C., ASSOC. M.INST.C.E.
PARKES, Charles Henry.
RUSSELL, Hon. F. A. Rollo, F.R.MET.SOC.

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CHART, Robert Masters.
HARDING, J. R., M.INST.C.E.
HOBSON, John Morrison, M.D., D.P.H.
HOLBERTON, Hy. Nelson, L.R.C.P., M.R.C.S., D.P.H.
MALTBY. Frederic Thomas, ASSOC.M.INST.C.E.
McINTOSH, James.
NUNN, F. C., ASSOC.M.INST.C.E.
PEAKE, Francis.
RUSSELL, HON. LADY Agatha.
SELBY. Prideaux.
SHAW, Josephus, M.R.C.S., L.S.A., M.O.H.
SHIRTLIFF, Edward Matthew, M.D., M.O.H.
STONE, W. H.
TOWNSEND, John Walter.

Associates:—

COLE, A. C.
CRANE, Stephen.
ELLIS, Stanley.
GOODWIN, Arthur Ayde.
HOOPER, Thomas Rowland.
INGRAM, William Jones.
KEAL, J.
MAYNE, John William.
NORRIS, Joseph.
PEARCE, Frederick James.
STEVENSON, John.
WELLS, William James.
WRIGHT, John, Junr.

SUSSEX.

Fellows:—

BELL, MAJOR C. W., J.P., D.L.
EWART, Joseph, M.D., F.R.C.P., J.P.
KELLY, Charles, M.D., F.R.C.P.
NEWSHOLME, Arthur, M.D., D.P.H., M.O.H.
STRONG, Henry John, M.D.

Members:—

ALLFREY, Charles Henry, M.D., F.R.C.S., D.P.H.
ASPINALL, Miles.
BEARD, E. T.
GIBBS, Arthur Gordon.
HARRIS, William John, M.R.C.S.E., L.S.A., F.R.MET.SOC.
HEAD, Henry.
HEAD, Mrs. H.
LOCKWOOD, Philip Causton, M.INST.C.E.
MORGAN, William Pringle, B.A., M.B., B.CH., D.P.H
SCOTT, Hugh Hamilton, ASSOC.M.INST.C.E.

Associates:—

BECK, William Coker.
BLACKMAN, Henry.
BOSTEL, G. Stanford.
BROWN, W. E.
GARDNER, C. T.
GRANT, Walter.
GRIVELL, Elias James.
HORLOCK, Charles William.
NORRISH, John Thomas.
OLLETT, John Henry.
SALTER, Thomas.
SMITH, Sydney.
WINTER, Edward.

WALES.

Fellows:—

DYKE, T. J., F.R.C.S.
REDWOOD, T. Hall, M.D.
VACHER, Francis, F.R.C.S.
WALFORD, Edward, M.D., D.P.H.CAMB., M.R.C.S., M.O.H.

Members:—

BAUGH, Alfred C.
BENNETT, Hugh, M.R.C.S.
DAYE, John.
DE SOLDENHOFF, Richard.
HARPUR, William, M.INST.C.E.
HUNT, John W.
PEEL, Edmund.
ROBERTS, Richard Lawton, M.D., D.P.H. CAMB., M.R.C.S., L.S.A.
STEEL, William D., M.D., M.O.H., D.P.H.
SWAINSON, John Henry, M.S.A., ASSOC.M.INST.C.E.
THOMAS, John, ASSOC.M.INST.C.E.
THOMAS, W. E. C., ASSOC.M.INST.C.E.
WILLIAMS, William, M.A., M.D., D.P.H. OXON., M.R.C.S., L.S.A.

Associates:—

ALLEN, William Henry.
DAVID, Philip.
DAVIES, Dan.
EVANS, John Isaac.
HUGHES, Edward J.
JONES, William.
KNOWLES, James Edward.
LOCK, G. H.
LONGSDON, Ernest M.

WALES—*Continued.*

MEAZEY, Thomas.
POWELL, David Henry William.
PROGER, John L.
ROBERTS, David Morris.
ROGERS, Richard.
ROWLAND, Samuel.

WARWICK.

Fellows:—

HILL, Alfred, M.D., M.R.C.S., L.S.A.
WILSON, George, M.A., M.D., F.R.S.E.

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Payment for which can be spread over 20 to 25 years, subject to the usual sanction of the Local Government Board.
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FOR HIGH AND LOW PRESSURE WATER AND STEAM,

Approved by the New River and other Water Companies. 20,000 sold.

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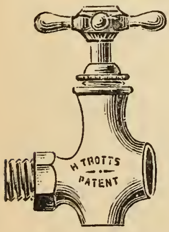
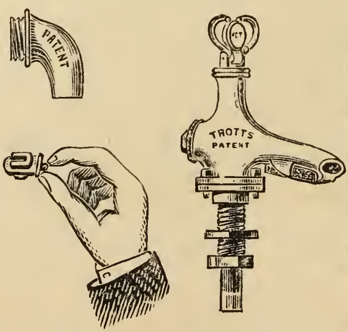
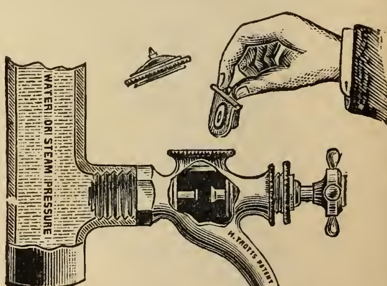


Full Way Valve.





Showing Moveable Valve whilst under Pressure.

SPECIALITY.—Valve Seatings **easily accessible** for Inpection and quickly and cheaply **renewable** by unskilled labour without necessity of interfering with any other parts of the valves or accessory connections.—An obviously invaluable advantage.

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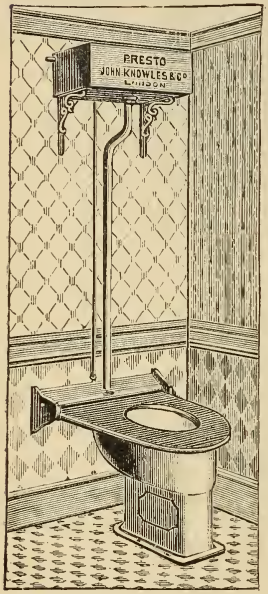
The "Presto" Self-Acting Seat and Cistern,

FIRST ACTION.
Ordinary use.



Closet Flushed on rising from seat.

ADAPTED TO ANY FORM OF FLUSHING CLOSET.

(PATENT.)

It is the first and only DOUBLE-ACTION Closet Seat.

There is no machinery.

Absolute cleanliness is ensured without attention.

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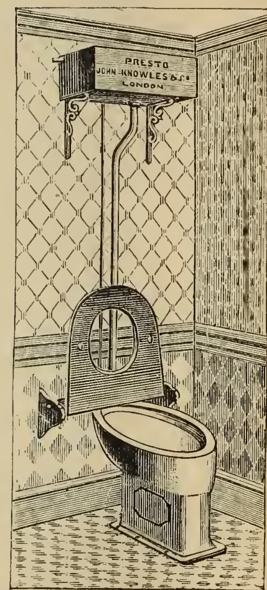
The *highest-priced* combination is **£4 10s.**, which includes an Ideal *Wash-down* White Pedestal Closet, Polished Mahogany Seat, and Cistern with Chain.

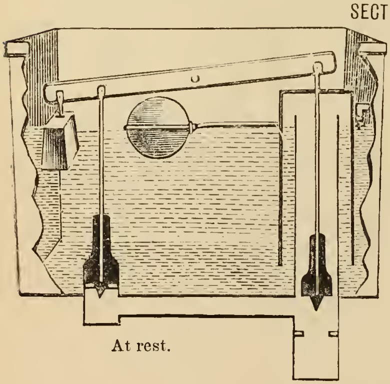
Cheaper combinations at much less prices can be made up.

SECOND ACTION.
For Slops, Urinals, &c.

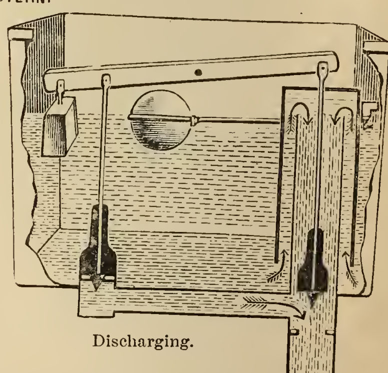


Closet Flushed by returning seat to normal position.

SECTIONS OF CISTERN.



At rest.



Discharging.

The duct and syphon pipe fill up ready for discharging by the valves being reversed when the seat is pressed down or lifted up during use.

A Large Stock kept of Sanitary Earthenware, Stoneware Drain Pipes, Terra Cotta Chimney Pots, Fire Bricks, Lime, Cement, Glazed Bricks, Tiles, &c., &c.

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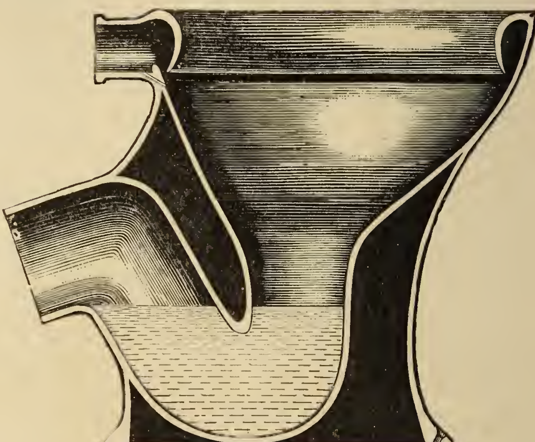

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CAN BE HAD WITH EITHER LEAD OR EARTHENWARE TRAP.

SEVERAL THOUSANDS OF THESE CLOSETS ARE NOW IN USE.

Our SYPHON CISTERN is specially suitable for this Closet, as it has a full $1\frac{1}{2}$in. water way in every part, and may be used with either $1\frac{1}{4}$in. or $1\frac{1}{2}$ in. pipe, and has no valves to get out of order.

BASINS AND TRAPS ONLY.

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No. 1.	Cane and White	1	7	0
No. 2.	All White	1	16	0
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If with raised ornamentation add 2s.

SYPHON CISTERNS ONLY.

2	Gall.	Cast-iron painted Cistern	1	0	0
3	,,	,, ,, ,, ...	1	5	0
2	,,	Galvanized Cast-Iron Cistern and Copper Cylinder ..	1	10	0
3	,,	,, ,, ,, ,, ,, ..	1	15	0

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CERTIFICATE OF MERIT, SANITARY INSTITUTE, 1889.

THE

"St. Bede Disinfectant."

(PATENTED. REGISTERED.)

A REAL DISINFECTANT!

Used by Medical Officers of Health.

TESTIMONIALS.

REPORT BY DR. EDWARD SEATON ON THE "ST. BEDE DISINFECTANT."

31st July, 1889.

Since it became established that the Per-Chloride of Mercury in the presence of a free acid, or its equivalent, was by far the most efficacious disinfectant, medical practitioners generally, and especially those who have to do with the prevention of fevers, have felt the great want of a convenient preparation which would contain the Per-Chloride of Mercury in the necessary strength together with a free acid, or its equivalent; and which would at the same time be in such a form as could be safely entrusted to Fever Nurses, Sanitary Inspectors and others by whom the processes of disinfection are usually carried out.

Such an article has now been prepared by the St. Bede Chemical Company. It is in the form of blocks, each weighing an ounce, and each containing 17·5 grains, or 4 per cent. of Per-Chloride of Mercury. The block is composed mainly of anhydrous sodium sulphate (392·4 grains), with which is combined 24·5 grains of sulphuric acid; the acid sulphate thus formed appearing to act like a free acid, and to give to the Per-Chloride of Mercury its full disinfecting or germ-destroying power. The block contains also 2·2 grains of eucalyptus and thymol and ·9 grains of indigo, so that when dissolved it has a strong, but pleasant, smell and a bright blue colour. I have had several of these blocks submitted to me for analysis, experiment, and report. I find the proportion of the Per-Chloride of Mercury in each to be as stated, viz., 4 per cent., or 17 grains in the ounce block. The block is rather slowly soluble in a quart of water. The resulting blue solution is described as a very strong disinfectant. In order to test this I have made experiments in conjunction with Dr. Klein, to ascertain the effect of the solution on certain well known organisms which have been proved to be pathogenic or constantly present in zymotic diseases. The tests were made with the bacilli and spores of anthrax, also with the organisms present in cases of cholera and enteric fever. On adding three drops of the culture fluids of these organisms to three cubic centimetres of the blue solution, consisting of one block dissolved in a quart of water, the organisms were destroyed after only five minutes' exposure. This is a very severe test and shows that the blue solution is a very strong disinfectant for infected linen, blankets, &c. We further tested its power of disinfecting the evacuations of enteric fever and cholera. Sterilised fœcal matter in a fluid condition was inoculated with as much as one-seventh part of the culture fluid of the organisms present in enteric fever. To this was added an equal quantity of the blue solution, and five minutes was found to be sufficient to destroy the organisms. I have also tested its antiseptic powers by dissolving a block in putrescible fluids, and I found that one block dissolved in twenty-five quarts of a putrescible fluid, retarded decomposition five days; and that when dissolved in twelve and a half quarts, there was no sign of decomposition in the putrescible fluid after eight days. I further tested its power as a deodorant by noticing its effect upon heaps of fish refuse mixed with other decomposing animal and vegetable matters, and I found the solution was an excellent deodorant.

The preparation called the "St. Bede Disinfectant" has most powerful disinfecting and antiseptic properties, and is also a valuable deodorant. At the same time its colour and smell are quite sufficient safeguards against the possibility of its mistaken use. I have therefore no hesitation in strongly recommending it on public grounds.

(Signed) EDWARD SEATON, M.D., F.R.C.P.,
Fellow of the Institute of Chemistry.
Medical Officer of Health for Chelsea,
Lecturer on Sanitary Science and Public Health, St. Thomas' Hospital, London

THE DETAILS OF THE EXPERIMENTS REFERRED TO IN DR. SEATON'S REPORT ARE AS FOLLOWS:—

The "St. Bede Disinfectant" was now in solution, one block being dissolved in one quart of water.

1.—The "killing power," i.e., the power to kill microbes, was tested on the following microbes: (A) bacillus anthracis without spores, (B) spores of bacillus anthracis, (C) the comma-bacillus found in Asiatic cholera, (D) the bacillus found in human typhoid fever

Of normal cultivations in broth of these several microbes, about three drops were added to about three cubic centimetres of the disinfectant solution, well mixed, and after the lapse of five minutes, one to two drops of the mixture were added to tubes containing about 10 c.c. normal sterile beef broth; for control similar normal sterile beef broth was inoculated with a mere trace of the same culture fluids used for the above experiments. All broth tubes were placed in the incubator at 37° C., while all the control tubes showed already after twenty-four hours' copious typical growth of the several microbes, the others were perfectly clear and remained so afterwards. It follows from these experiments that five minutes' exposure of bacillus anthracis, of spores of bacillus anthracis, of the choleraic bacilli, and of the typhoid fever bacilli to the "St. Bede Disinfectant" solution is sufficient to kill these microbes.

2.—An important and extremely severe test of the killing power of the "St. Bede Disinfectant" solution was made in the following experiments:—

To normal human fœcal matter in thick solution, previously sterilised and contained in test tubes, was added a certain quantity of normal culture fluid of the choleraic bacilli and of the typhoid fever bacilli respectively, about one-seventh of the culture fluid being added to six-sevenths of the fœcal solution. After mixing well the disinfectant was added to each of the fœcal mixtures in equal proportions, so that each of the test tubes contained $\frac{1}{2}$ of the fœcal matter plus culture fluid, and $\frac{1}{2}$ of the disinfectant. After five minutes a number of test tubes containing sterile beef broth, as in the former series, were inoculated with a drop or two from these fœcal mixture tubes, then placed in the incubator and kept at 37° C., but no growth appeared in them and the fluids remained sterile. At the same time that the above experiments were made, control broth tubes were inoculated with a trace of the fœcal solution after the addition to them of the culture fluids, but before the addition of the disinfectant, these control tubes were also placed in the incubator and kept at 37° C., they all showed abundant normal growth after twenty-four hours of the choleraic bacilli and of the typhoid bacilli respectively.

(Signed) E. KLEIN, M.D., F.R.S.,
Professor of Bacteriology at the College of State Medicine, London.

LABORATORY AND ASSAY OFFICE,
75, THE SIDE, NEWCASTLE-UPON-TYNE,
July 6th, 1889.

I hereby certify that I have analysed a sample of the "St. Bede Disinfectant," manufactured by Messrs. The St. Bede Chemical Company (Limited), Newcastle-upon-Tyne, and that I find it contains as follows:—

Per-Chloride of Mercury	4·01	per cent.
Free Sulphuric Acid	4·10	,,
Sulphate of Soda	87·25	,,
Sulphate of Lime	1·30	,,
Oxide of Iron, &c.	0·27	,,
Chloride of Sodium	0·21	,,
Insoluble Siliceous Matter	0·24	,,
Thymol, Eucalyptus, Indigo, and Water	2·62	,,
	100·00	

The principal active ingredient of this disinfectant is Per-Chloride of Mercury (corrosive sublimate) which is known to be the most certain and powerful destroyer of disease germs. When the "St. Bede Disinfectant" is dissolved according to the instructions given it forms a solution of the strength and character recommended by Dr. Buchanan, the Medical Officer of the Local Government Board, as being effective as a disinfectant. It is prepared and packed in a form which makes it convenient and easy to be used.

(Signed) JOHN PATTINSON, F.I.C., F.C.S.
Public Analyst for Newcastle-upon-Tyne.

SPECIAL TERMS FOR LARGE QUANTITIES.

NOW MANUFACTURED ONLY BY

The Hedworth Barium Company,

NEWCASTLE-UPON-TYNE.